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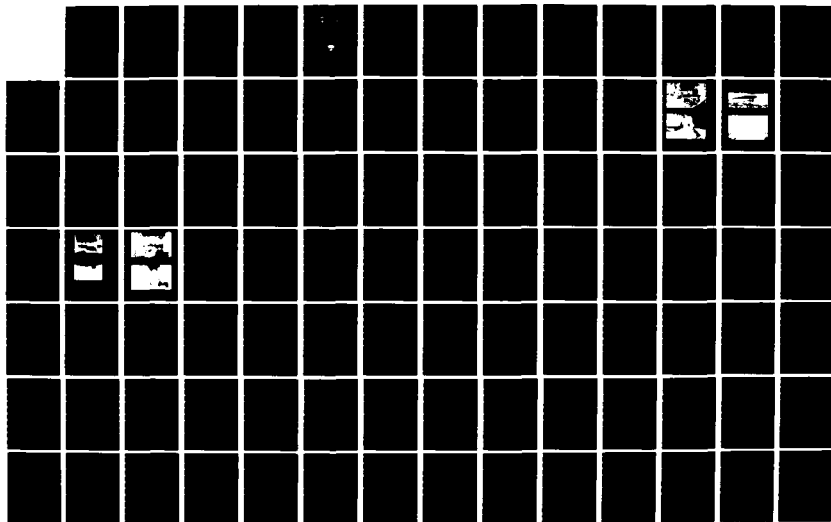
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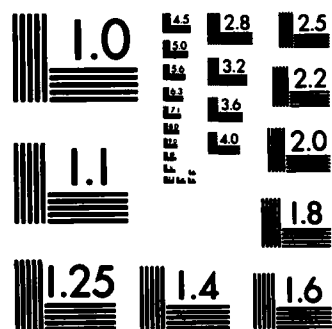
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BASSETT CREEK WATERSHED

HENNEPIN COUNTY, MINNESOTA

FEASIBILITY REPORT FOR FLOOD CONTROL



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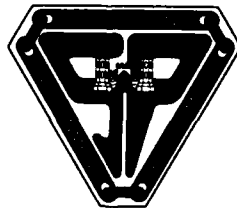
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1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) FLOOD CONTROL, BASSETT CREEK WATERSHED, HENNEPIN COUNTY, MINNESOTA, DESIGN MEMORANDUM No. 2, PHASE II, GENERAL PROJECT DESIGN		5. TYPE OF REPORT & PERIOD COVERED
6. AUTHOR(s)		6. PERFORMING ORG. REPORT NUMBER
7. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Corps of Engineers, St. Paul District 45 USPO and Custom House Paul, MN 55101		8. CONTRACT OR GRANT NUMBER(s)
9. CONTROLLING OFFICE NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE
		13. NUMBER OF PAGES
		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) FLOOD CONTROL URBAN AREAS MINNESOTA WATERSHEDS		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The flood control plan for the Bassett Creek watershed involves a combination of nonstructural and structural measures. Nonstructural measures include flood proofing residences and evacuation of one residence in the upper watershed, and continuance of local flood plain ordinances modified to reflect proposed conditions. Two principal structural measures are: a new conduit to replace the existing one outletting Bassett Creek to the Mississippi River, and the other, a series of small control structures in the upper watershed.		

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BARNETT CREEK WATERSHED

HENNEPIN COUNTY, MINNESOTA

FEASIBILITY REPORT FOR FLOOD CONTROL



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MARCH 1976

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The purpose of this study was to determine the best solution to the water and related land resource needs in the Bassett Creek watershed, Hennepin County, Minnesota. Several severe floods have occurred in recent years resulting in damages to residences and commercial and industrial establishments and threatening the health and well-being of area residents. The flood threat is expected to increase with continued urbanization of the watershed. Therefore, alternative measures for flood control were evaluated to identify the plan which would best meet the needs of the people.

The plan selected by the District Engineer as the most practical plan of improvement includes both nonstructural and structural measures. Non-structural measures include flood proofing 19 residences; evacuation of three residences; and continuation of existing flood plain regulation, flood insurance and flood forecasting, flood warning and emergency protective measures in unprotected and undeveloped areas of the watershed. The plan includes two principal structural measures; a new conduit to replace the existing conduit outletting Bassett Creek to the Mississippi River and a series of small control structures to temporarily impound flood waters. Also included in the plan are; a limited reach of channel widening and snagging and clearing, road raises, bridge removals, culvert replacements, a weir structure, a marsh impoundment for flood storage and wildlife enhancement and a recreation trail system.

The estimated total first-cost for the proposed project would be \$10,140,000. Annual charges and annual benefits would be \$633,000 and \$949,700, respectively. The benefit cost ratio is 1.50.

Table of Contents

<u>Item</u>	<u>Page</u>
THE STUDY AND REPORT.	1
PURPOSE AND AUTHORITY	1
SCOPE OF STUDY	1
THE FEASIBILITY REPORT.	2
PRIOR STUDIES AND REPORTS.	3
RESOURCES AND ECONOMY OF THE STUDY AREA	5
ENVIRONMENTAL SETTING AND NATURAL RESOURCES.	7
CLIMATE	7
TOPOGRAPHY	8
SOILS	8
GEOLOGY	9
WATER SUPPLY.	9
WATER QUALITY	10
AIR QUALITY	11
VEGETATION	14
FISH AND WILDLIFE	16
HISTORICAL AND ARCHAEOLOGICAL RESOURCES.	18
RECREATION	18
HUMAN RESOURCES	20
DEVELOPMENT AND ECONOMY	23
TRANSPORTATION	26
LAND USE	27
PROBLEMS AND NEEDS	28
FLOODING	29

Table of Contents (Continued)

<u>Item</u>	<u>Page</u>
FLOODS OF RECORD	29
PRESENT FLOOD DAMAGES	33
FUTURE FLOOD DAMAGES	34
WATER SUPPLY AND WATER QUALITY	34
PARKS AND RECREATION	36
STREAM BANK EROSION	37
PUBLIC HEALTH AND SAFETY	38
FISH AND WILDLIFE	38
EXISTING PROJECTS	39
IMPROVEMENTS DESIRED	40
PLAN FORMULATION	42
POSSIBLE SOLUTIONS	43
ALTERNATE SOLUTIONS FOR FLOOD CONTROL	43
NONSTRUCTURAL ALTERNATIVES	44
NO ACTION--MAINTAIN BASE CONDITION (Alternate 1)	44
PERMANENT FLOOD PLAIN EVACUATION (Alternate 2)	45
FLOOD PROOFING - PARTIAL EVACUATION (Alternate 3)	45
STRUCTURAL MEASURES	46
FLOOD STORAGE AND CHANNEL MODIFICATION WITH REPAIR OF EXISTING CONDUIT (Alternate 4-A)	49
FLOOD STORAGE AND CHANNEL MODIFICATION WITH A NEW CONDUIT IN NON-HIGHWAY RIGHT-OF-WAY (Alternate 4-B)	49
FLOOD STORAGE AND CHANNEL MODIFICATION WITH NEW CONDUIT IN THIRD AVENUE DISTRIBUTOR RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 4-C)	49

Table of Contents (Continued)

<u>Item</u>	<u>Page</u>
FLOOD STORAGE AND CHANNEL MODIFICATION WITH A NEW CONDUIT - INTERSTATE 94 RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 4-D).	50
FLOOD STORAGE AND CHANNEL MODIFICATION WITH AN OPEN SPACE-OPEN CHANNEL CORRIDOR TO THE MISSISSIPPI RIVER (Alternate 4-E)	50
FLOOD STORAGE AND DIVERSION WITH REPAIR OF EXISTING CONDUIT (Alternate 5-A)	51
FLOOD STORAGE AND DIVERSION WITH A NEW CONDUIT IN NON-HIGHWAY RIGHT-OF-WAY (Alternate 5-B)	51
FLOOD STORAGE AND DIVERSION WITH A NEW CONDUIT IN THIRD AVENUE DISTRIBUTOR RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 5-C)	52
FLOOD STORAGE AND DIVERSION WITH A NEW CONDUIT - INTERSTATE 94 RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 5-D)	52
FLOOD STORAGE AND DIVERSION WITH AN OPEN SPACE-OPEN CHANNEL CORRIDOR TO THE MISSISSIPPI RIVER (Alternate 5-E)	52
COMBINATIONS OF NONSTRUCTURAL AND STRUCTURAL ALTERNATIVES	52
FLOOD STORAGE AND FLOOD PROOFING WITH REPAIR OF EXISTING CONDUIT (Alternate 6-A)	52
FLOOD STORAGE AND FLOOD PROOFING WITH A NEW CONDUIT IN NON-HIGHWAY RIGHT-OF-WAY (Alternate 6-B)	53
FLOOD STORAGE AND FLOOD PROOFING WITH NEW CONDUIT IN THIRD AVENUE DISTRIBUTOR RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 6-C)	53
FLOOD STORAGE AND FLOOD PROOFING WITH A NEW CONDUIT - INTERSTATE 94 RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 6-D).	53
FLOOD STORAGE AND FLOOD PROOFING WITH AN OPEN SPACE-OPEN CHANNEL CORRIDOR TO THE MISSISSIPPI RIVER (Alternate 6-E)	54

Table of Contents (Continued)

<u>Item</u>	<u>Page</u>
OTHER ALTERNATIVES CONSIDERED	54
EVALUATION OF ALTERNATIVES	55
ALTERNATIVES SELECTED FOR FURTHER ANALYSIS	62
CONTRIBUTIONS OF ALTERNATIVES TO NATIONAL OBJECTIVES.	65
NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN	65
ENVIRONMENTAL QUALITY (EQ) PLAN	65
DEVELOPMENT OF THE SELECTED PLAN	70
COMPARISON OF IDENTIFIED PLANS	71
THE SELECTED PLAN	73
PLAN DESCRIPTION.	73
NONSTRUCTURAL FEATURES.	73
GOLDEN VALLEY ROAD (COUNTY ROAD 66) TO DRESDEN LANE.	73
NOBLE AVENUE TO UPSTREAM OF HIGHWAY 100	74
PLYMOUTH CREEK UPSTREAM OF MEDICINE LAKE	74
NORTH BRANCH UPSTREAM OF LOUISIANA AVENUE NORTH	74
SWEENEY LAKE BRANCH	74
STRUCTURAL FEATURES.	75
MISSISSIPPI RIVER TO IRVING AVENUE NORTH	75
IRVING AVENUE NORTH TO GLENWOOD AVENUE	77
GLENWOOD AVENUE TO DRESDEN LANE	78
DRESDEN LANE TO UPSTREAM OF HIGHWAY 100.	79
UPSTREAM OF HIGHWAY 100 TO MEDICINE LAKE	81
NORTH BRANCH FROM 29TH AVENUE NORTH TO LOUISIANA AVENUE NORTH	83
AESTHETIC AND ENVIRONMENTAL CONSIDERATIONS	85

Table of Contents (Continued)

<u>Item</u>	<u>Page</u>
RECREATIONAL CONSIDERATIONS	85
IMPACTS OF THE SELECTED PLAN	86
ECONOMIC IMPACTS OF FLOOD CONTROL	86
PROJECT COSTS.	86
FLOOD DAMAGES AND PROJECT BENEFITS.	87
FLOOD CONTROL BENEFITS	88
RECREATION BENEFITS	89
ADVANCE REPLACEMENT BENEFITS	89
REDEVELOPMENT BENEFITS	90
SUMMARY OF MONETARY BENEFITS	90
ECONOMIC JUSTIFICATION	91
IMPACTS ON THE NATURAL ENVIRONMENT	92
SOCIAL AND CULTURAL IMPACTS	96
RECREATION.	96
HUMAN ASPECTS.	98
AESTHETIC ASPECTS	99
DIVISION OF PLAN RESPONSIBILITIES.	100
COST APPORTIONMENT	102
PLAN IMPLEMENTATION	104
COORDINATION WITH OTHER INTERESTS AND PUBLIC INVOLVEMENT	106
SUMMARY	116
STATEMENT OF FINDINGS.	119
RECOMMENDATIONS.	127

Tables

<u>Item</u>	<u>Page</u>
AVERAGE ANNUAL FLOOD DAMAGES	34
ECONOMIC IMPACTS OF FLOOD DAMAGE REDUCTION ALTERNATIVES FOR THE BASSETT CREEK WATERSHED.	59
RANKING OF ALTERNATIVES	64
SYSTEM OF ACCOUNTS.	72
SUMMARY OF ESTIMATED PROJECTED COSTS.	87
SUMMARY OF AVERAGE ANNUAL BENEFITS	91
SUMMARY OF AVERAGE ANNUAL BENEFITS AND COSTS	91
APPORTIONMENT OF COSTS AMONG INTERESTS	103
ANNUAL CHARGES	103

Figures

<u>Item</u>	
HISTORIC AND PROJECTED POPULATION.	22
EDUCATIONAL STATISTICS	23
HISTORIC AND PROJECT PER CAPITA INCOME	24
HISTORIC AND PROJECTED EMPLOYMENT.	24
1970 OCCUPATION STATISTICS	25
PRESENT LAND USE	27
PROJECTED FUTURE LAND USE	28

Photographs

DEVELOPMENT IN THE FLOOD PLAIN ALONG THE MAIN STEM OF BASSETT CREEK IMMEDIATELY DOWNSTREAM OF GLENWOOD AVENUE . . .	12
VIEW OF THE SOUTH HALF OF RICE LAKE IN GOLDEN VALLEY	13
BASSETT CREEK UPSTREAM OF HIGHWAY 100 IN CRYSTAL.	13

Photographs (Continued)

	<u>Page</u>
APRIL 1975 FLOOD NEAR INLET TO EXISTING CONDUIT IN MINNEAPOLIS	30
JUNE 1972 FLOOD AT SCOTT AVENUE AND WESTBEND AVENUE IN GOLDEN VALLEY.	31
JUNE 1975 FLOOD AT DRESDEN LANE IN GOLDEN VALLEY.	31

Plates

Plate No.

1	LOCATION
2	SELECTED PLAN
3	RECREATION FEATURES

BASSETT CREEK WATERSHED
HENNEPIN COUNTY, MINNESOTA
DRAFT FEASIBILITY REPORT
FOR FLOOD CONTROL

THE STUDY AND REPORT

PURPOSE AND AUTHORITY

The Bassett Creek watershed is located within the Minneapolis-St. Paul metropolitan area and entirely within Hennepin County. The watershed contains portions of nine municipalities: Crystal, Golden Valley, Medicine Lake, Minneapolis, Minnetonka, New Hope, Plymouth, Robbinsdale and St. Louis Park and is tributary to the Mississippi River. Past flood occurrences in the watershed have not been frequent until recent years with flooding occurring in June 1974 and in May and June 1975. The potential for flooding along Bassett Creek is expected to increase with urbanization of the watershed.

At the request of local interests through their representatives in Congress, the Committee on Public Works of the House of Representatives adopted a resolution on 24 September 1970, requesting a study of the flood and related land resource problems in the Bassett Creek watershed. A resolution by the Committee on Public Works of the United States Senate adopted 7 April 1962, provides additional authority.

SCOPE OF STUDY

The study reviews the water and related land resource problems and potential solutions to these problems for the entire Bassett Creek watershed. A continuous program of public involvement was conducted throughout the study to identify the plan which best meets flood damage reduction needs and would be responsive to the desires of the affected public. Reasonable alternative plans to solve the areas' water resource

problems were considered and several plans were studied in detail including cost and benefit estimates. The selection of the most feasible plan was made after considering all factors including the expressed concerns of Federal, State and local interests. The study provides a basis for more detailed future studies.

THE FEASIBILITY REPORT

The purposes of this feasibility report are: (1) to summarize current and potential problems, needs and alternatives for flood control purposes in the Bassett Creek watershed; (2) to present and discuss the results of plan formulation which develops a resource management system for the watershed; (3) to identify specific details of the selected plan; and (4) to acquaint the public with information obtained and conclusions drawn during the feasibility studies. Much of the data presented in this study was discussed with public and special interest groups. The feasibility report evaluates engineering, economic, environmental and social effects of possible flood control alternatives to develop an overall plan for the basin. The study was conducted in compliance with the September 1973 Water Resources Council, Principles and Standards for Planning Water and Related Land Resources, and was coordinated with the Level B Study currently being conducted in the metropolitan area. The study is compatible with the Upper Mississippi River Basin Comprehensive Study.

In the interest of clarity and presentation, the report has been arranged into a main report with two appendixes. The main report is a general nontechnical presentation of the feasibility study of water and related land resources in the Bassett Creek watershed. This basic document presents a broad view of the overall study and is intended for the general reviewer. Included in the main report are plan formulation and selection procedures, division of project responsibilities between Federal and non-Federal interests and recommendations for implementing the selected plan.

The technical report is divided into two appendices. Appendix 1 is a technical report providing greater detail of the basic information contained in the main report. Following the same general outline as the main report, it is the key document for the technical reviewer. Appendix 2 contains pertinent correspondence affecting the coordination with Federal and State agencies and local interests and a summary of public involvement activities conducted during the study.

PRIOR STUDIES AND REPORTS

Several previous studies of the existing and potential flood and water resource related problems on the Bassett Creek watershed have been completed. These studies and reports provide valuable information regarding the water resource problems and needs of the area and recommended solutions to meet those needs. Studies of the watershed include:

- a. A preliminary report on the storm water drainage problems in the watershed and a plan to provide protection from a 10-year frequency storm was prepared by a consulting engineering firm in 1961. The report recommended storage sites and channel improvements throughout the watershed to provide that protection.
- b. A review survey report was completed by the St. Paul District Corps of Engineers on 25 November 1966 in response to a resolution adopted by the United States Senate, Committee on Public Works, 7 April 1962. This study indicated that a flood damage reduction plan would be economically feasible. The study was terminated due to the absence of the required assurances of local cooperation.
- c. The plan of investigation for flood control and related purposes prepared for Bassett Creek on 6 May 1963 was revised 5 October 1970, by the St. Paul District Corps of Engineers in accordance

with a Senate Committee on Public Works resolution adopted 7 April 1962, and by a House Committee on Public Works resolution adopted 24 September 1970. The revised plan of investigation in cooperation with the Bassett Creek Flood Control Commission was presented and approval was recommended.

- d. A Watershed Management Plan for Bassett Creek was prepared and adopted by the Bassett Creek Flood Control Commission on 18 May 1972. The plan delineated the 100-year frequency flood plain and established a "management envelope" or elevation below which future development would be restricted. The management of this "envelope" will preserve the various options available for flood control until a plan which meets the needs of the public can be implemented.
- e. The Upper Mississippi River Comprehensive Basin Study was completed in July, 1972. This study prepared under the supervision of the Upper Mississippi River Basin Coordinating Committee presents data for a framework program for development and management of water and related land resources of the Upper Mississippi River Basin which includes the Bassett Creek watershed.
- f. Comprehensive land use zoning and drainage plans have been prepared and adopted by most of the communities in the Bassett Creek watershed. In addition, all of the communities in the watershed are in the process of preparing flood zone ordinances in accordance with the 1969 Minnesota Flood Plain Management Act.
- g. A preliminary Feasibility Report for Flood Control for Bassett Creek was prepared by the Bassett Creek Flood Control Commission in September, 1974. The report summarized current and potential problems and needs in the Bassett Creek watershed and presented the results of a preliminary examination of the alternatives for flood control in the Bassett Creek watershed.

The preliminary feasibility report made recommendations regarding the need for the extent of further studies regarding flood control on Bassett Creek.

- h. A limited Archaeological Reconnaissance for the Bassett Creek watershed flood control area was conducted in November, 1975 by the St. Paul District Corps of Engineers. Nothing of historical or archaeological significance was found. However, a potential for culturally valuable sites is felt to exist and an intensive archaeological survey will be accomplished during the advance planning phase.
- i. A Level B Study is currently being conducted in the seven-county metropolitan area. The study is a reconnaissance level evaluation of the water and related land resources in the metropolitan area. The study will identify water and related land resource problems and needs as perceived by area residents and will develop alternative measures to satisfy those problems and needs consistent with their attitudes and preferences. Flooding along metropolitan area streams, the installation of fish barriers, and the protection of wetlands and flood plains are among the problems identified by the Level B Study Team. Because the Bassett Creek watershed has been the subject of intensive study efforts, the Level B Study will monitor the planning process in the Bassett Creek watershed as input in recommending alternative measures for other streams in the area.

RESOURCES AND ECONOMY OF THE STUDY AREA

The Bassett Creek watershed is located within the Minneapolis-St. Paul metropolitan area and is considered an urban watershed. The creek is an aesthetic meandering stream which enhances residential development and serves as a setting for parks, walkways and recreational areas. In several areas of the watershed, wetlands and natural areas remain amidst the rapidly urbanizing area.

The original settlement of the Minneapolis-St. Paul metropolitan area began in 1820 by the establishment of the Fort St. Anthony Military Reservation (renamed Fort Snelling in 1825) at the confluence of the Minnesota and Mississippi Rivers. The Minnesota River and the Mississippi River provided the transportation base for the future industrial development of the area. In addition, the Mississippi River provided a central source of power for the early industrial development in the area. The flour milling and lumbering industries and their supportive activities established the Minneapolis-St. Paul metropolitan area as the regional trade, financial and transportation center of the upper midwest. Although lumbering is no longer a viable industry in the metropolitan area, the food processing industries along with printing and publishing, the manufacture of precision instruments, computers, electronic equipment, electrical machinery and transportation machinery are important to the economy of the area. At the present time, no single industry or group of industries dominate the economy of the Minneapolis-St. Paul metropolitan area.

Among its important resources are the educational facilities available to the people of the Minneapolis-St. Paul metropolitan area. There are thirteen colleges and universities, six junior colleges and seven area vocational-technical schools in the immediate area. In addition, the University of Minnesota hospitals, their research facilities and medical schools have gained world renown.

There is a high degree of flexibility in the location of residential and commercial development in the Minneapolis-St. Paul metropolitan area because of the diversified transportation system. Two major interstate highways serve the metropolitan area from out-state areas and an outer interstate ring circling Minneapolis and St. Paul provides an efficient link between suburban areas. Public transportation is provided by an extensive network of regular and express bus service routes which are operated by the Metropolitan Transit Commission. The Twin Cities area is also served by six major railroads, eight airlines, an extensive trucking system, and barge service on the Mississippi and Minnesota Rivers.

ENVIRONMENTAL SETTING AND NATURAL RESOURCES

Bassett Creek drains approximately 42 square miles and originates upstream of Medicine Lake in the sparsely developed areas of the City of Plymouth. The creek flows east through Golden Valley, Crystal and Minneapolis to the Mississippi River, the last portion of which is through a 1-1/2 mile conduit. The creek enters the Mississippi River less than one mile upstream of the Upper St. Anthony Falls Lock and Dam near River Mile 855. Between Medicine Lake and its confluence with the Mississippi River two branches, the North Branch and Sweeney Lake Branch, join the main stem of Bassett Creek. The North Branch drains portions of Plymouth, New Hope and Crystal, and joins the main stem immediately upstream of Highway 100. The Sweeney Lake Branch drains portions of the St. Louis Park and Golden Valley and joins the main stem in Theodore Wirth Park near Golden Valley Road. A map of the watershed is shown on Plate 1.

CLIMATE

The climate of the area is moderate, characterized by large seasonal variations in temperature, normally sufficient rainfall for crops, and moderate snowfall. The summers are warm and moderately humid, with short periods of hot, very humid weather occasionally occurring during the summer months. The winters are usually cold and moderately humid.

Intense summer thunderstorms are common and are occasionally accompanied by tornado activity. A record summer storm recorded at the Minneapolis-St. Paul International Airport occurred in July 1951, during which a maximum wind velocity of 92 miles per hour was recorded and 2.93 inches of rainfall fell in a 6-hour period. Five tornadoes were reported in Hennepin County during this same storm period. Winter storms with high winds causing severe blizzard conditions occur occasionally. The worst winter storm of record occurred on 10-11 January 1975, with winds up to 60 mph and 7 inches of snow in a 24-hour period were recorded in the

vicinity of the watershed. The record 24-hour snowfall at the Minneapolis-St. Paul International Airport was 16.2 inches on 12 November 1940.

The mean annual temperature for the Bassett Creek watershed is 44°F. The mean monthly temperature varies from 12°F in January to 73°F in July. Extreme temperatures recorded were a high of 108°F on 14 July 1936, and a low of -34°F on 1 January 1936.

Annual precipitation for the Bassett Creek watershed averages 26 inches and has ranged from a low of 11.5 inches in 1910 to a high of 40.1 inches in 1911. The mean monthly precipitation varies from 4.0 inches in June to 0.7 inches in January. About 70 percent of the precipitation occurs during the growing season. Snowfall averages 44 inches annually and represents about 17 percent of the total precipitation. Extreme snowfall records range from 88.9 inches during the 1950-51 season to 14.2 inches during the 1930-31 season.

TOPOGRAPHY

The topographic relief of the Bassett Creek watershed is about 210 feet. the boundary of the watershed rises from Elevation 980 west of Parkers Lake to Elevation 1010, northwest of Lost Lake. From this point east, the northern and southern boundaries drop to approximately Elevation 800 where the creek enters the Mississippi River. The natural drainage patterns of the watershed are generally not well developed and the area is interspersed with marshland and irregular hills and knolls.

SOILS

The surface soils throughout the central portion of the Bassett Creek watershed are generally well drained and have a surface layer of grayish loam or clay loam and a subsoil of light clay loam. They are moderately permeable and have high available moisture capacity. In the western portions of the Bassett Creek watershed, the soils have a surface layer of very

dark brown sandy loam and a subsoil of dark yellowish brown sandy loam. The surface soils in the eastern portion of the watershed were formed under prairie vegetation and have a dark surface horizon that grades into a bright brown colored subsoil. Larger medium sands are typical of these soils.

GEOLOGY

The Bassett Creek watershed is located in the northwestern portion of a bedrock structure underlying Minneapolis-St. Paul metropolitan area, which has a gentle slope to the southeast. The bedrock is overlain by 200 feet of glacial drift in the western portions of the watershed and approximately 25 feet in the southeastern portion of the watershed in Minneapolis. The watershed is underlain by five major bedrock aquifers: the St. Peter Sandstone, Prairie-du-Chien Dolomite, Jordan Sandstone, Franconia-Galesville Sandstones and the Mt. Simon-Hinckley Sandstones. In addition, there are numerous aquifers in the glacial drift.

WATER SUPPLY

The existing average daily consumption of water for municipal and industrial purposes in the Minneapolis-St. Paul metropolitan area has been estimated to be approximately 327 million gallons per day. Of this amount, approximately 40 percent is obtained from surface water supplies and 60 percent is obtained from ground water aquifers. The City of Minneapolis withdraws approximately 77 million gallons of water per day from the Mississippi River for municipal and industrial purposes. In addition, the City of Minneapolis supplies Golden Valley, Crystal and New Hope with water. Plymouth, Robbinsdale, Minnetonka, St. Louis Park and Medicine Lake obtain their water supplies from bedrock aquifers. The dependence on these source for municipal and industrial supplies is not expected to change with increased future demand. In the extreme western portions of the Bassett Creek watershed, some residents still obtain their domestic water supplies from

private supply wells. The respective municipal supplies either presently serve or are presently scheduled to serve these areas in the near future. It can, therefore, be expected that within the foreseeable future, the domestic water supply throughout the watershed will be dependent upon municipal water supply systems.

WATER QUALITY

The Minnesota Pollution Control Agency (MPCA) has classified Bassett Creek in the Fisheries and Recreation category (Category 2) in the MPCA's Rules and Regulations (Minn. Reg. WPC 14). The Fisheries and Recreation category is further broken down into Class A, B and C waters based on a required range or limit of designated water quality parameters. Bassett Creek is in the B class and the overall standard classification for the stream is referred to as 2B. The 2B classification requires water of adequate quality to propagate and maintain both sport and commercial fisheries as well as aquatic recreation of all kinds including swimming.

A limited amount of water quality data is available for the Bassett Creek watershed. The Minnesota Pollution Control Agency (MPCA) operated two continuous water quality monitoring stations on Bassett Creek from 1960 to 1965. In 1972, the Bassett Creek Flood Control Commission initiated a water quality monitoring program for Bassett Creek as well as for the major lakes and ponds in the watershed. The water quality monitoring data collected during the first year indicated that the creek did not meet the MPCA standards in the summer months. Later results of the water quality monitoring program on Bassett Creek have indicated seasonal variations in sampling parameters, with the summer months demonstrating increased fecal coliform counts not meeting 2B standards.

The Bassett Creek Flood Control Commission has collected water quality data for the five major lakes and also for several ponds within the watershed which provides valuable information concerning biological, chemical and physical conditions of these lakes. Summarizing the available lake

quality data, Twin Lake has the lowest biological productivity and could be termed the least eutrophic. Sweeney Lake has the second lowest biological productivity and is second to Twin Lake in water transparency. Past data shows that the biological productivity of Medicine Lake has been increasing at a rapid rate during the last thirty years. The overall state of eutrophication of Medicine Lake does, however, appear to be near optimum for fish production. Parkers Lake has average chlorophyll concentrations similar to Sweeney Lake, but the transparency is lower, indicating that suspended inorganic material may be contributing to the turbidity. Wirth Lake had the highest sustained chlorophyll concentrations as well as the highest primary production and the lowest transparency of the five lakes which could sufficiently reduce the aesthetic value of the lake for park and recreation use.

The quality of the ground water in the watershed is generally good. The ground water ranges from moderately hard to hard with high iron concentrations. Recognized sources of ground water pollution include septic tank and cesspool seepage and industrial discharges. Infrequent occurrences of localized contamination of the glacial drift aquifers and uppermost bedrock aquifers have been noted.

AIR QUALITY

Air quality information is available from four air quality sampling stations in the vicinity of the watershed. There are air quality sampling stations in Wayzata and St. Louis Park, which are representative of the western and central portions of the watershed. Minneapolis has numerous stations located around the central portion of the city, two of which provide data representative of the eastern portion of the watershed. Except for isolated instances, the data collected at these stations indicate that air quality in the watershed generally conforms to air quality standards established by the Minnesota Pollution Control Agency.



Development in the Flood Plain Along the
Main Stem of Bassett Creek Immediately
Downstream of Glenwood Avenue



A View of the South Half of Rice Lake
in Golden Valley



Bassett Creek Upstream of Highway 100 in Crystal

VEGETATION

Prior to settlement, the watershed was covered by two major cover types. From the Mississippi River to Medicine Lake, the watershed was covered by a predominantly oak forest interrupted by tall grass prairie and marsh. The area west of Medicine Lake was covered by a dense deciduous climax forest known as the "Big Woods". Elm, sugar maple and basswood are representative tree species. Scattered remnants of this forest are still present throughout much of its original range.

Natural vegetation in the Bassett Creek watershed has been greatly altered by agricultural development and urbanization. With farming rapidly diminishing in the watershed, urbanization is occurring in former agricultural areas and pressures to develop existing natural areas and wetlands is occurring. The remaining wetland areas are concentrated in the western part of the watershed.

Flood plain forests are very common throughout the watershed forming a narrow strip along much of the creek as well as predominating many of the lowlying undeveloped areas. Various stages of ecological succession are evident in this category as a result of periods of occasional flooding as well as clearing practices which have occurred due to the constant pressures of urban development. Vegetation patterns in this category are highly variable, ranging from light-tolerant samplings, shrubs, and forbs to a near climax community of dominating light-tolerant trees with a shade-tolerant understory. Because the watershed is in the process of urbanization, many small and scattered stands of variable cover type are present.

Upland hardwood forests can be found in small scattered stands throughout the watershed. However, due to the pressure of agricultural development followed by urban development, this type has been removed from the majority of its original range. Areas where this vegetative category can still be found are in Theodore Wirth Park and in scattered tracts

in the northwestern portion of the watershed. Dominant tree species include oaks (primarily bur and red), elm, basswood, maple, with interspersed ash, horn beam, aspen, birch, wild cherry, hickory, butternut and black walnut.

The remaining marsh areas in the watershed are near the edges of lakes, along the margins of the creek itself or are scattered remnants of lowlying areas which have been filled or drained. Marsh areas are subject to frequent flooding due to their low elevations, especially during spring snowmelt and following intense summer rain storms. These areas provide valuable open space in this rapidly urbanizing area. Biologically, these sites are highly productive, sustaining both plant and animal organisms that are of basic importance in the food chains of higher animals.

Residential areas occupy the majority of the land area in the watershed. Originally, these areas were wooded or marsh lands which have been cleared or filled to facilitate construction of homes. Portions of this category are located within the flood plain and subject to flood damages. Residential development ranges from almost total in Minneapolis to about 25 percent in Plymouth. The seven other municipalities are approaching total development, with the present development trend moving from east to west. Most of the municipalities in the watershed have or are formulating comprehensive development plans.

Remnants of forest cover as well as landscaped plants provide shade and shelter for many homes in these residential areas and add to the aesthetic quality of the watershed. Common species in the landscaped plants include a variety of maples, weeping willow, flowering plums, linden and numerous flowering shrubs and herbaceous material. Many yards adjacent to Bassett Creek resemble prime parkland. Included in this category are the numerous recreation areas located throughout the watershed, which provide habitat for birds and small mammals.

Industrial-commercial development along the creek is heaviest in Golden Valley along the reach from T. H. 55 to Winnetka Avenue and in Minneapolis

from Glenwood Avenue to the outlet of the creek. Mature woody vegetation is generally lacking in this category with primary tree species being young aspen, boxelder and willow. Most herbaceous vegetation has been removed to facilitate development, however, annual forbs and grasses frequently reestablish themselves on bare ground in these development areas.

FISH AND WILDLIFE

Fish and wildlife species in the Bassett Creek watershed area maintain a high degree of diversity considering the on-going urbanization of the area. In all, 282 species of birds, 96 species of fish, 57 species of mammals and 33 species of amphibians and reptiles occur in the seven-county metropolitan area. It is expected that most of these species can be found in the Bassett Creek watershed as evidenced by the diversity of habitat available.

Recent studies by Federal and state agencies indicate that over 30,000 ducks are annually produced in the metropolitan area with mallard, blue-winged teal and wood duck being the most common nesting species. An expanding Canada goose population annually produces about 500 goslings in the area. A flock of 60 geese is maintained on a large commercial property in Golden Valley as well as by many individuals in the area who maintain a few geese on backyard ponds. Nearly 14,000 ducks have been known to winter over on open ponds and streams in the metropolitan area. Several hundred have been observed using open water areas along Bassett Creek. Due to the existing urbanization, hunting is prohibited within the watershed, however, rural areas within easy commuting distance of the watershed provide many acres for potential hunting.

Upland game birds present in the watershed include pheasants, ruffed grouse and some Hungarian partridge. The ruffed grouse population is limited within the watershed due to habitat requirements. With favorable climatic conditions, pheasants are numerous in the western semi-agricultural part of

the watershed. State game records of August road counts made in Hennepin County between 1950 and 1974 demonstrate wide fluctuations in the pheasant population. Variables such as climate, food and cover can account for wide fluctuation in the counts. Other small game species present include gray squirrels, cottontail rabbit and white-tailed jackrabbit.

According to the Minnesota Department of Natural Resources (DNR), commercial trapping is conducted on an individual basis in some parts of Hennepin County. Although no trapping statistics are available for the Bassett Creek watershed, it is assumed by the DNR, that individuals are operating on a small scale in the less inhabited parts of the watershed. Species taken include: muskrat, red fox, and some mink.

The white-tailed deer is the only big game species remaining in Hennepin County and the watershed. About 1,000 deer kills are reported annually in the seven-county metropolitan area, many of these being automobile victims. The deer population in the metropolitan area is estimated by the DNR to be about 8,000 with the major river valleys being preferred habitat areas.

Important non-game bird species in the watershed include the starling, pigeon, house sparrow and crow. These species appear to be on the increase, competing for food and nesting sites with other more desirable species such as robins, bluebirds and woodpeckers.

Shore birds, gulls and terns are common inhabitants to water environments, especially during spring and fall migration. Several species of hawks and owls nest in the area. Falcons, osprey and eagles pass through the area during migration. Many species of shore birds and song birds use the area for breeding and nesting as well as feeding and resting stops during migration.

Bassett Creek watershed contains ample resources for recreational and sport fishing. Fish populations vary from lake to lake due to the diversity and quality of habitat provided. Four of the five major lakes in the watershed provide bass and panfish and some northern pike angling. The Minnesota Department of Natural Resources has conducted lake surveys on Sweeney Lake

and Medicine Lake in the watershed. It was noted that spawning conditions in both lakes were good for bass and panfish, fair to good for northern pike and poor for walleye. Bassett Creek contains carp, bullheads, sunfish and a variety of minnows. Bassett Creek along with the smaller lakes and ponds provides fishing for many youngsters in the area.

Turtles, frogs, toads and other species of reptiles and amphibians are frequently found in sloughs, marshes, side channels of lakes and in Bassett Creek itself. Some of the more common species include leopard frog, common toad, painted turtle, spotted salamander and garter snake.

The variety of aquatic and terrestrial invertebrates in the watershed would number into the thousands of species and include groups such as insects, earthworms, clams and snails.

HISTORICAL AND ARCHAEOLOGICAL RESOURCES

Coordination with state and county historical societies and a review of both the National and State Registers of Historic Sites reveals several sites of architectural, archaeological, or historic significance in the general vicinity of the watershed. None of the identified sites would be affected by the project. A surface archaeological reconnaissance of the project area did not identify any sites of historical or archaeological significance, however, the reconnaissance did identify areas of high and low archaeological potential in the project area. Those areas identified by the reconnaissance will be subject to intensive archaeological investigation during future project studies.

RECREATION

An abundance of water- and land-based recreational facilities are located around the Minneapolis-St. Paul metropolitan area. Easily accessible from the watershed are one Federally-owned and four State-owned recreation areas. In addition, the Hennepin County Park Reserve District has established six park reserves in the metropolitan area. With these six park reserves, the District now owns most of the property necessary to serve the projected

needs of the county's present and future populations. A regional park has been proposed for the northwest end of Medicine Lake. This new regional park has been incorporated into the Metropolitan Council's Recreation Open-Space Plan. The proposed regional park on Medicine Lake will be the only regional park within the watershed.

The eastern portion of the watershed including the municipalities of Minneapolis, Crystal, Robbinsdale, New Hope, St. Louis Park, and Golden Valley meet existing recreational needs with neighborhood parks and playgrounds located throughout these communities. In this portion of the watershed, active recreational facilities are dominant, especially in Crystal and Robbinsdale. Rapid urbanization has interfered with the planned development of passive recreation open space as well as trail or walkway systems. This problem is most severe in areas with relatively dense development as well as those where low income neighborhoods are dominant. In those more densely developed portions of the watershed, trails and natural areas for studying and enjoying the natural environment are few.

The municipalities of Minneapolis, St. Louis Park and Golden Valley have existing or are developing passive recreational areas or nature centers. Theodore Wirth Park along with the Eloise Butler Wildflower Garden provide Minneapolis and Golden Valley residents with passive recreation opportunities. Golden Valley is developing natural areas along Bassett Creek in the area of Rice Lake and along the main stem of Bassett Creek north of Minnaqua Avenue and north of Duluth Street. The area north of Minnaqua Avenue has been officially designated as the Briarwood Bird Sanctuary by the City of Golden Valley. St. Louis Park is developing a nature center in the Westwood Lake area. Robbinsdale is currently acquiring land in the area of the north end of Rice Lake to form a natural area in conjunction with Golden Valley on the south end. The existing or proposed trail systems serve as interconnecting links between recreational facilities, commercial areas and schools within these communities.

Trail systems within the municipalities in the eastern and central part of the watershed range from on-street routes to off-street limestone

or asphalt paths. Robbinsdale and Crystal are developing an on-grade system along low traffic residential streets using direction and traffic control signs as needed to delineate and preserve the trails. Golden Valley and New Hope have a combination of on-grade and off-grade systems. The main connecting routes are on-grade with scenic links through parks and along Bassett Creek. Minneapolis provides an off-grade trail through Theodore Wirth Park as part of this continuous trail system which will circle much of the city. Intercommunity trail linkage, as well as connection with the Minnesota Department of Natural Resources' Luce Line Trail in Plymouth, is being discussed by several communities in the watershed.

Plymouth and Minnetonka occupy the western portion of the watershed and are not as urbanized as the communities in the eastern part of the watershed. Planned development of recreational facilities is in the land acquisition phase in Plymouth and Minnetonka. Existing recreational needs are being met and continued planning will anticipate and provide for future recreational needs. Both active and passive recreational facilities are being planned as well as a system of hiking and biking trails.

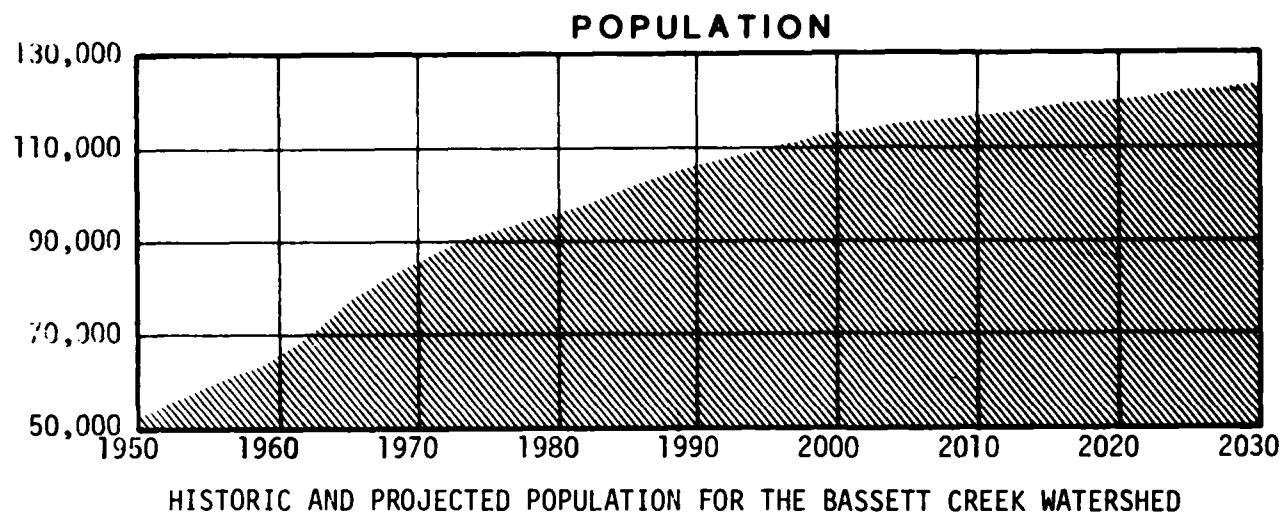
Special use areas such as golf courses and lakes provide year-round activities. The Brookview Community Golf Course, the Hollydale Golf Course and the Theodore Wirth Golf Course, along with Felders Golf Center, are public use facilities. The Golden Valley Country Club golf course in Golden Valley and the Minneapolis Golf Club golf course in St. Louis Park are private facilities. As well as providing golf in the summer months, the public courses serve a multiple-use function by providing cross-country skiing during the winter months.

HUMAN RESOURCES

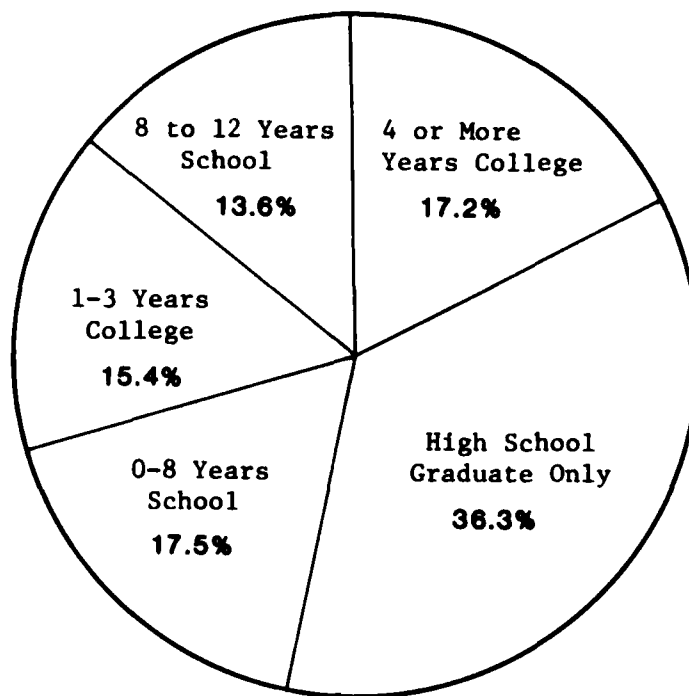
The Bassett Creek watershed lies entirely within Hennepin County; one of the seven counties within the Minneapolis-St. Paul metropolitan area. The Metropolitan Council independently compiles census data and forecasts population, employment and number of households for each municipality within the

seven-county metropolitan area. The 1970 estimated population for the Bassett Creek watershed was 87,400. Population density varies widely through the watershed, but averages 3.2 people per acre while the average 1970 population density in the Minneapolis-St. Paul SMSA was 1.3 people per acre. This indicates that the Bassett Creek watershed is significantly more urbanized than the Minneapolis-St. Paul SMSA. The portion of the watershed in Minneapolis is the most densely populated, averaging 9.6 people per acre, while Plymouth is the most sparsely populated, averaging less than one person per acre. The watershed's population was estimated to be 92,600 in 1974, which represents an increase of 5.9% since 1970 and is projected to be 122,000 by 2030, which represents a 90% increase from 1970.

A large portion of the Bassett Creek watershed, especially Crystal, Medicine Lake, Minneapolis, New Hope, Robbinsdale and St. Louis Park, are considered to be near total urbanization and, therefore, no major changes in population due to migration is expected within these municipalities. The majority of future urbanization in the watershed will occur in Plymouth. That portion of the watershed within Plymouth is expected to increase from 1974 population of 12,000 to approximately 30,000 in 2000 and to approximately 37,000 in 2030. The communities of Golden Valley and Minnetonka are projected to have slow population growth. The projected population for Golden Valley is 29,300 in 2030 and for the portion of the watershed in Minnetonka, the projected population is 2,820 in 2030. Historic and projected population data are shown on the figure below.



Educational levels attained by residents of the watershed are generally higher than those of residents of the entire State of Minnesota or of the nation. This insures an attractive labor force for the existing and future economic activity in the area. Educational statistics for the Bassett Creek watershed are illustrated on the figure below.



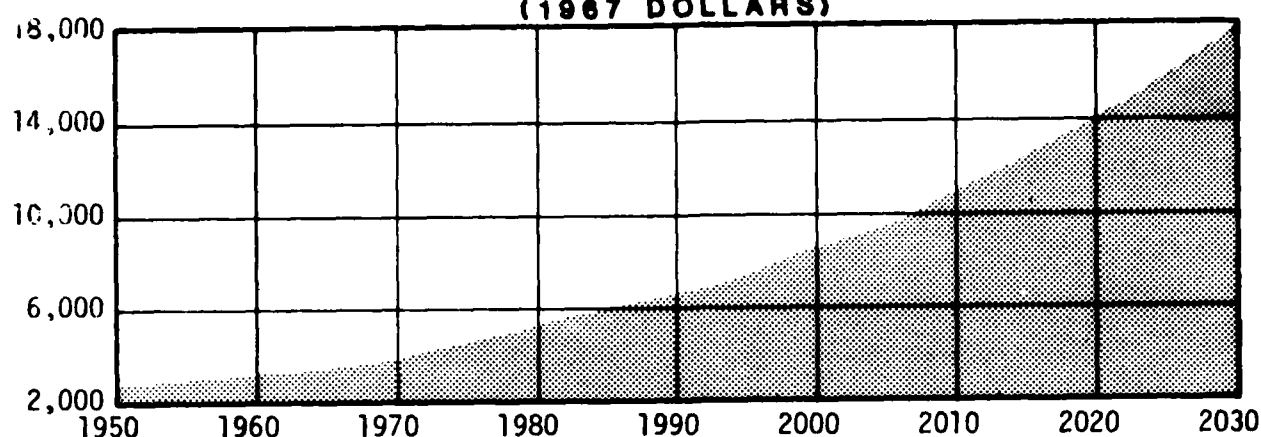
1970 EDUCATION STATISTICS FOR THE BASSETT CREEK WATERSHED

DEVELOPMENT AND ECONOMY

The estimated average annual per capita income in the Bassett Creek Watershed was \$3,850 in 1970, which is slightly greater than average annual per capita income in the Minneapolis-St. Paul SMSA. Per capita income for the Minneapolis-St. Paul SMSA increased 64% between 1950 and 1970. The average annual per capita income for the Minneapolis-St. Paul SMSA is projected to increase to \$17,500 and represents an increase of 325% between 1970 and 2030. Historic and projected average annual per capita income statistics for the Minneapolis-St. Paul SMSA are illustrated by the figure below.

DOLLARS PER CAPITA

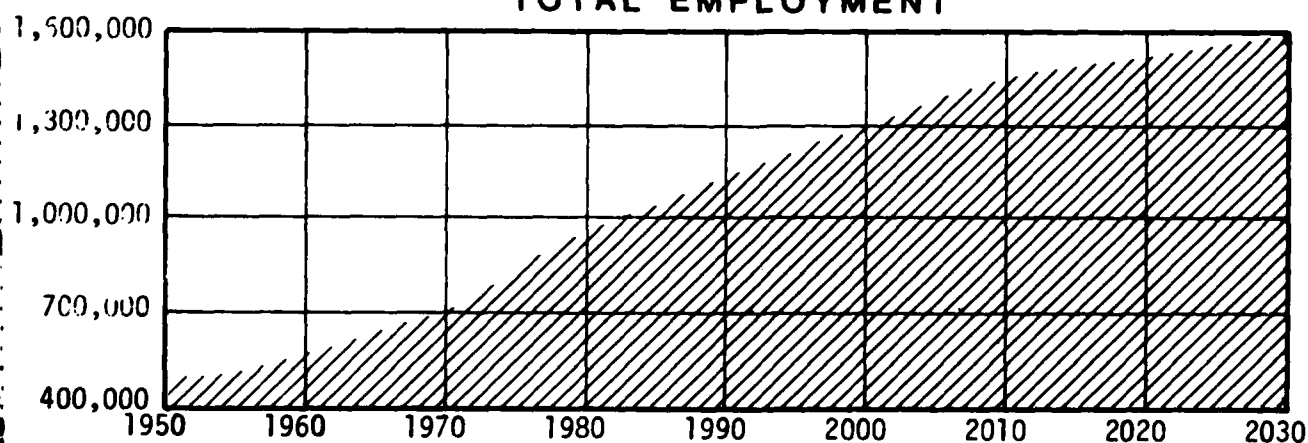
(1987 DOLLARS)



HISTORIC AND PROJECTED PER CAPITA INCOME - MINNEAPOLIS-ST. PAUL SMSA

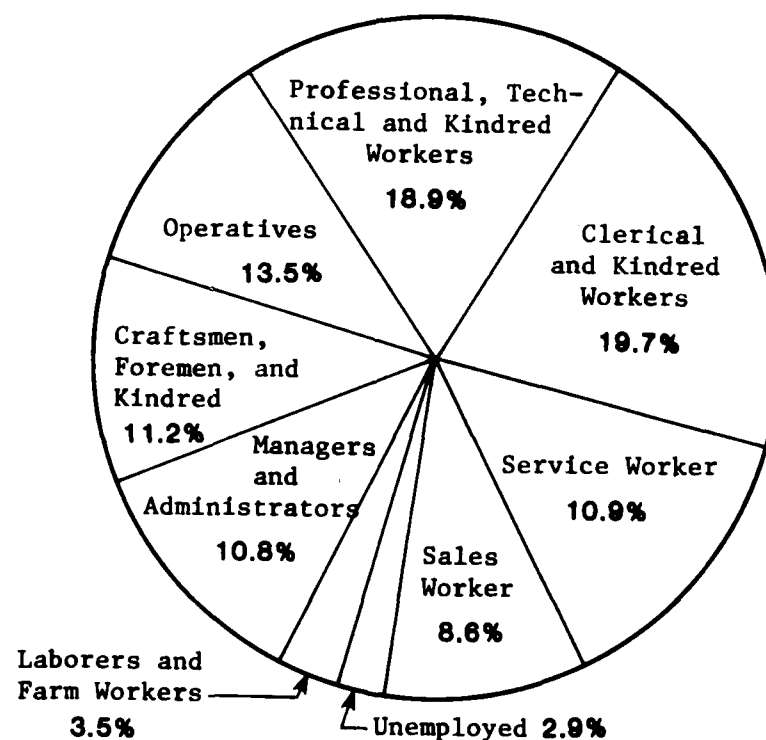
Between 1960 and 1970, total employment increased 30.8% in the Minneapolis-St. Paul SMSA. Mining, services, durable goods manufacturing and wholesale trade had the greatest percentage increase. Between 1970 and 1980, the retail trade and the services industries are projected to have the greatest percentage increase in employment. Due to increased urbanization within the Minneapolis-St. Paul SMSA, employment in agriculture declined significantly between 1960 and 1970 and will continue to decline between 1970 and 1980. Since the unemployment rates and employment by occupation statistics for the Bassett Creek watershed and the Minneapolis-St. Paul SMSA are similar, employment projections for the Minneapolis-St. Paul SMSA provide a reasonable basis for the projected employment within the Bassett Creek watershed. Historic and projected employment statistics for the Minneapolis-St. Paul SMSA are illustrated on the figure below.

TOTAL EMPLOYMENT



HISTORIC AND PROJECTED EMPLOYMENT - MINNEAPOLIS-ST. PAUL SMSA

Clerical or related occupations are the most common occupations of residents in the Bassett Creek watershed. The second most common occupation of residents in the watershed is the professional, technical and related fields. The remaining occupations in order of their prevalence are: operative; craftsmen, foremen and kindred workers; service workers; managers and administrators, sales workers; and laborers and farm workers. In the watershed, the distribution of the labor force among the occupational categories is similar to the distribution in Hennepin County and the Minneapolis-St. Paul SMSA. The 1970 occupation distribution of the Minneapolis-St. Paul SMSA is illustrated on the figure below.



1970 OCCUPATION STATISTICS FOR THE BASSETT CREEK WATERSHED

Source: United States Census of Population and Housing,
Department of Commerce, Bureau of the Census, 1970.

The Bassett Creek watershed occupies an area of approximately 42 square miles on the western edge of the rapidly expanding Minneapolis-St. Paul metropolitan area. At the present time, approximately 60% of the watershed's total area is in a state of total or partial urbanization. The state of urbanization varies from total in Minneapolis to negligible in the western portions of Plymouth. In those communities which have experienced considerable growth within the last 15 years, the contemporary patterns of land utilization are apparent. Although many of these areas can be considered fully urbanized, the density of residential, commercial and industrial developments is far less than that in Minneapolis. Further west in the communities of Minnetonka and Plymouth, the density of urban development becomes even less and urban planning to retain more park and open space is underway in anticipation of future growth.

Commercial and industrial development is distributed throughout the Bassett Creek watershed. As urbanization has progressed westward through the watershed, commercial and industrial areas have developed along major highways and rail transportation facilities. Retail shopping centers are distributed throughout the watershed and provide convenient and diversified shopping locations for the residents of the watershed.

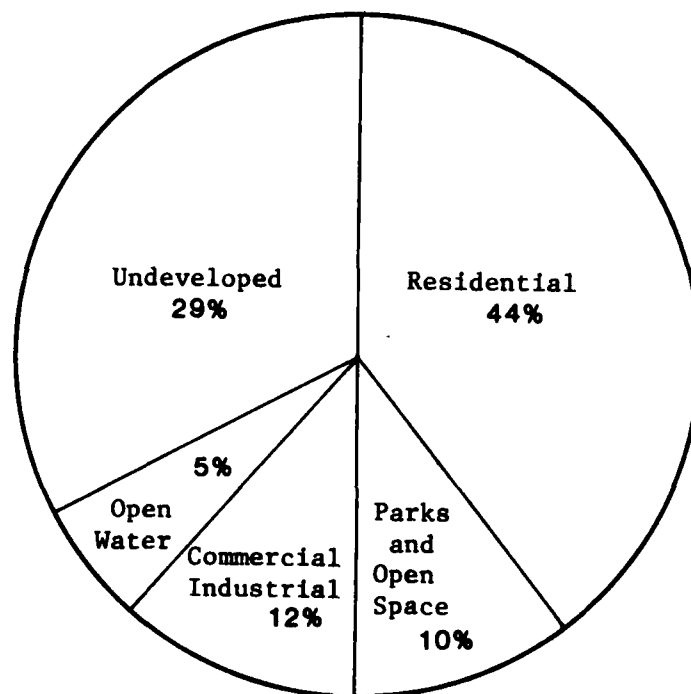
TRANSPORTATION

There is a high degree of flexibility in the location for residential and commercial development in the Twin Cities metropolitan area because of the diversified transportation system. Two major interstate highways serve the metropolitan area from outstate areas and an outer interstate ring circling the Twin Cities provides an efficient transportation link between suburban areas. Public transportation is provided by an extensive network

of regular and express bus service routes which are operated by the Metropolitan Transit Commission. The Twin Cities area also is served by six major railroads, eight airlines, an extensive trucking system and barge service on the Mississippi and Minnesota Rivers.

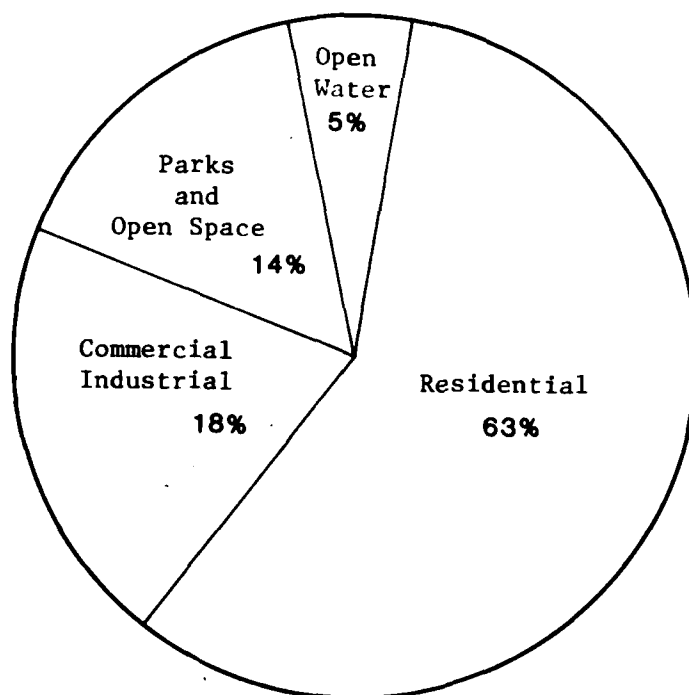
LAND USE

At the present time, approximately 29 percent of the area of the watershed is undeveloped. The primary land use is residential comprising approximately 44 percent of the total watershed area while commercial and industrial land use comprises approximately 12 percent. Lands for parks, open space, public and semi-public use account for approximately 10 percent and approximately 5 percent of the total area within the watershed is occupied by open water. Approximately 11 percent of the total area of the watershed is within the 100-year flood plain. The respective flood plain land uses are: residential, 21 percent; commercial-industrial, 9 percent; parks, open space, public and semi-public, 20 percent; open water, 40 percent; and undeveloped land, 10 percent. Various existing land uses within the watershed are illustrated by the figure below.



PRESENT LAND USE
BASSETT CREEK WATERSHED

The primary future land use in the Bassett Creek watershed is expected to be residential comprising about 63 percent of the watershed. The second largest anticipated future land use is commercial-industrial which comprises approximately 18 percent of the watershed area. The future land use in the park, open space, public and semi-public category will be approximately 14 percent of the watershed area. The projected future land use for the Bassett Creek watershed is illustrated by the figure below.



PROJECTED FUTURE LAND USE
BASSETT CREEK WATERSHED

PROBLEMS AND NEEDS

The problems and needs of the Bassett Creek watershed considered in this report include the existing and potential flood situation, water supply, water quality, water and land based recreation and fish and wildlife conservation.

FLOODING

Periodic flooding of commercial and residential development constitutes one of the most serious problems in the Bassett Creek watershed. The areas subject to frequent flooding include residential areas in the upper watershed and industrial and commercial lands in the lower watershed. Parks, golf courses and other recreational areas throughout the watershed are also subject to frequent flooding. The larger floods will inundate residential areas near the conduit entrance in addition to the industrial and commercial areas. Several major highways and railroads throughout the watershed will also be inundated. The large commercial and industrial area in Minneapolis is especially susceptible to flood damage because it is located immediately upstream of the 1.5 mile conduit which serves as an outlet for the entire Bassett Creek watershed. Only small flows can be carried by the existing conduit without inundating the surrounding commercial and industrial development. The existing conduit is in a state of general disrepair. Failure of any section of the conduit during a large flood or the accumulation of debris would further reduce the discharge capacity of the conduit, causing catastrophic flooding in the area of the conduit entrance. A 50 percent blockage would cause flooding of more than 250 acres. In addition to public properties and utilities, more than 450 residential dwellings and more than 80 industries would be flooded. It is estimated that the resulting flood damages would be in excess of \$8 million in the proximity of the existing conduit entrance.

FLOODS OF RECORD

Floods which have occurred on Bassett Creek have occurred both from summer rainstorms and spring snowmelt runoff. The large number of isolated flooding events which have occurred have been recorded in little or no detail. Residents have indicated that while most of the isolated instances of damaging floods along Bassett Creek have resulted from summer rainstorms, flooding has not been strictly limited to that cause.

A recent incidence of severe flooding in the Bassett Creek watershed occurred on 27 April 1974 as a result of a long duration spring rainstorm. Approximately 2-1/4 inches of rain fell in a 24-hour period throughout the



April 1975 Flood Near Inlet to Existing
Conduit in Minneapolis



June 1972 Flood at Scott Avenue and
Westbend Avenue in Golden Valley



June 1975 Flood at Dresden Lane
in Golden Valley

watershed. Although this storm approximated a 1-year frequency rainfall event, its effects were probably comparable to a 25-year frequency runoff event due to antecedent conditions. A substantial spring snowmelt ended approximately 15 April and was followed by several days of moderate precipitation. As a result of the snowmelt and subsequent period of moderate precipitation prior to the 27th, the soils throughout the watershed were in a saturated condition and much of the natural upland depression storage was full prior to the rainfall event of 27 April. As a result of this storm, flood damage was incurred in Golden Valley, New Hope, Crystal and Minneapolis. A serious result of this storm was the damage incurred as a result of sanitary sewer backup into many homes in Golden Valley, New Hope and Crystal caused by excessive infiltration into wastewater collection facilities. In addition, many street intersections in the flood plain of Bassett Creek were inundated as a result of this storm.

Severe flooding also occurred in the Bassett Creek watershed on 6 June 1974, as a result of an intense summer rainstorm. Approximately 3-1/2 inches of rain fell in a 6-hour period in the western portion of the watershed, while approximately 2-1/4 inches of rain fell in that 6-hour period in the eastern portions of the watershed. The most intense portions of the storm in the western portion of the watershed approximated a 25-year frequency rainfall event. As a result of this storm, flood damage was incurred in Golden Valley, New Hope, Crystal and Minneapolis. A more serious result of this storm was the damage incurred as a result of sanitary sewer backup in many homes in Golden Valley, Crystal and New Hope caused by excessive infiltration into wastewater collection facilities. In addition, many street intersections and low areas outside the flood plain of Bassett Creek were inundated as a result of this storm.

A more severe flood occurred in June, 1942. This flood was significant because of the damage which was incurred by the commercial and industrial establishments in Minneapolis. If a flood of this magnitude were to occur at this time, damages of approximately \$1.6 million would occur in Minneapolis and damages of approximately \$470,000 would be sustained throughout the remainder of the watershed.

On September 1903, severe flooding occurred in Minneapolis in the area of the conduit inlet.¹ Reportedly, 5 inches of rain fell in 10 hours causing extensive flooding along Bassett Creek in North Minneapolis. Bassett Creek "overflowed its banks and some four hundred acres in the center of the city were flooded".² As the flood receded and "for weeks afterwards, the heavy fog and stench arising from this entire section, due to the decay (of) vegetation, was intolerable and must have been injurious to public health".³ While this is the only information available regarding this flooding event, it is apparent that the impacts of this event on the residents of Minneapolis was significant.

If a flood having a 1% chance of occurring every year (100-year frequency) were to occur in the Bassett Creek watershed, approximately 2,700 acres, 222 residences and 18 industries would be flooded along the creek. This does not include the area or developments which would be flooded as a result of a conduit failure or blockage.

PRESENT FLOOD DAMAGES

Present flood damages include both tangible and intangible losses. Tangible losses suffered during floods include inundation damage to structures, utilities and transportation facilities, flood fighting costs, post-flood cleanup costs, business losses and increased expenses for normal operating and living during a flood situation. Intangible losses suffered include loss of life, human misery during a flood occurrence, disruption of normal community activities, potential health hazards from contaminated water and food supplies, dislodged fuel storage tanks and flooding of sewage collection facilities. Flood damages in the Bassett Creek watershed presently average about \$461,500 annually as shown in the table below.

¹ Report on the Feasibility of Diverting Bassett Creek Through the Lakes to Minneahaha Falls. Committee from the Minneapolis Real Estate Board, the West End Improvement Association, the Oak Lake Improvement League, the Linden Hills Improvement Association, the Calhoun Improvement Association, and the Oak Park Improvement Association, December 24, 1904.

² Ibid.

³ Ibid.

AVERAGE ANNUAL FLOOD DAMAGES - EXISTING URBANIZATION
BASSETT CREEK WATERSHED

<u>Average Annual Flood Damage</u>			<u>Increase in Damage 1980-2030</u>	<u>Average Annual Equivalent of Increase Over 100-Year Project Life</u>	<u>Total Average Annual Equiv- alent Damages Over 100-Year Project Life</u>
1975	1980	2030			
\$493,900	516,500	857,100	340,600	105,800	622,300
Index 100	105	174			

FUTURE FLOOD DAMAGES

Without flood protection in the Bassett Creek watershed, all tangible and intangible flood losses now occurring could occur on an increased scale in the future. Changes in the type and extent of flood damages will result from on-going urban renewal programs, land use shifts and continued residential, industrial and commercial development, where permitted under flood plain regulations. With increased urbanization of the watershed, flood damages will gradually increase at a rate proportional to the growth in property values, structural replacements and increased runoff. The value of the contents of the structures would also increase with time. Due to the flood plain regulations now being promulgated, vacant land in the flood plain will either be used for recreational purposes in the future, or if developed, new structures will be flood proofed. It has been assumed in this study that the existing developed portion of the floodplain remains constant.

WATER SUPPLY AND WATER QUALITY

The City of Minneapolis withdraws approximately 77 million gallons of water per day from the Mississippi River for municipal and industrial water supply purposes. In addition, the City of Minneapolis supplies Golden Valley, Crystal and New Hope with water. Plymouth, Robbinsdale, Minnetonka, St. Louis Park and Medicine Lake obtain their water supplies from the Prairie-du-Chien-Jordan or the Mt. Simon-Hinckley bedrock aquifers. The

dependence on these sources for municipal and industrial water supplies is not expected to change with increased future demand.

The water quality of the ground water available in the metropolitan area is generally good. The water ranged from moderately hard to hard and high iron and manganese concentrations are common. Recognized sources for ground water pollution include septic tank and cesspool seepage and industrial discharges. These sources have caused localized contamination of glacial drift aquifers and the uppermost bedrock aquifers.

The chemical quality of the surface water sources presently used for domestic water supply is generally good. Problems are limited to excessive hardness, turbidity and color. Although the surface waters are classified as moderately hard, hardness, iron and manganese concentrations tend to be somewhat lower than the available ground water sources. Bacteriological quality of surface water is substantially poorer than most ground waters and, in some cases, the raw water supply drawn by Minneapolis contains coliform organism counts in excess of the river standards established by the Minnesota Pollution Control Agency. This water is treated to meet drinking water quality standards. Identified sources of surface water pollution in the vicinity of the metropolitan area include domestic and industrial waste from upstream areas, combined storm-sanitary sewer overflows, septic tank system seepage, runoff from agricultural lands and polluted runoff from urban areas.

Municipal wastewater in the Bassett Creek watershed is collected by a system of wastewater interceptors and is treated at the Metropolitan Wastewater Treatment Plant at Pigs Eye on the Mississippi River or at the Blue Lake Treatment Plant on the Minnesota River. These collection facilities and treatment plants are operated and maintained by the Metropolitan Waste Control Commission. Stormwater is collected by separate storm sewer systems except in portions of Minneapolis where the separation of the combined storm and sanitary sewer system is currently in the initial stages. In the municipalities of Golden Valley, Crystal and New Hope,

periods of intense rainfall have in the past resulted in sanitary sewer backup problems caused by excessive infiltration into wastewater collection facilities. The Metropolitan Waste Control Commission and the municipalities involved are taking action to correct this problem.

The water quality in Bassett Creek is subject to seasonal variation. The water quality monitoring program conducted by the Bassett Creek Flood Control Commission has indicated the seasonal variation in sampling parameters, with the summer months demonstrating increased fecal coliform counts which do not meet the Minnesota Pollution Control Agency's 2B Stream Standard (Minn. Reg. WPC 14). The water quality monitoring program currently being undertaken by the Bassett Creek Flood Control Commission is intended to locate the sources of contamination and, with the cooperation of the MPCA, improve the existing water quality.

PARKS AND RECREATION

The several major parks in the watershed offer a wide variety of recreational facilities and opportunities. Brookview Community Golf Course, the Hollydale Golf Course, and the Theodore Wirth Golf Course are public facilities, and in addition, two private golf courses are located in the watershed. In the winter, cross-country skiing, downhill skiing, and sledging are also popular in Theodore Wirth Park and several of the community parks throughout the watershed. Wirth Lake, Sweeney Lake, Twin Lake and Medicine Lake offer opportunities for fishing, boating, sailboating and canoeing. The total area of park and publicly owned open space in the watershed exceeds 1,400 acres and the total water surface area of the major lakes is approximately 1,200 acres.

Generally, the recreational facilities available to the general public in Hennepin County are adequate to meet existing needs. However, studies have shown that to remain adequate, the rate of development and acquisition of park land must keep pace with the increasing population. In the Bassett Creek watershed, there appears to be a general lack of local recreational

facilities geographically spaced so that they are readily accessible to people with limited transportation. In the more densely developed portions of the watershed, separated bikeways and natural areas for studying and enjoying the natural environment are few. In areas where existing development is scattered, many local recreation facilities have not been developed at this time, thus creating a temporary and artificial limitation on the geographical spacing of these facilities. As development pressure requires the development of future facilities, this geographical limitation will be significantly reduced.

In Minneapolis, a large portion of the property immediately adjacent to Bassett Creek is publicly owned, except where the creek flows in the conduit, and access to the creek exists at several points. Although a developed recreation trail does not exist at the present time, the Bassett Creek Valley through Minneapolis could be developed to link bike and walkways along Wirth Parkway and in the Bryn Mawr Meadows Park, providing a potential trail system of approximately 2.5 miles. In other portions of the watershed, private property abuts the creek and the potential for hiking and walking along the creek is restricted to short reaches. Separated bikeways and walkways have been planned and are being developed in Golden Valley and Plymouth, however, only short sections of the proposed trails follow the creek.

STREAM BANK EROSION

Throughout the Bassett Creek watershed, the increased normal flows and flood flows resulting from continued urbanization of the watershed have caused increased erosion and subsequent siltation problems. As urbanization of the watershed continues in the future, increased normal flows and flood flows will result in further increases in the erosion and subsequent siltation of the stream bed. These increased flows will cause the creek to increase its tendency to meander through the flood plain and will affect the existing natural and unnatural vegetation along the channel banks. In some areas of the watershed this increased tendency to meander has become readily apparent in recent years. In some reaches, the root systems of trees along the edge of the channel have been undermined by flowing water causing the

trees to lean over the channel and eventually die. In some reaches of the creek where residential properties abut the creek, residents have expressed concern because of the erosion of the stream bank, the loss of portions of their lawns and in some instances, the movement of the channel causing the loss of portions of their usable property. This loss of vegetation and trees along the channel bank caused by the tendency of the creek to meander can be expected to increase in the future.

PUBLIC HEALTH AND SAFETY

The health and safety of residents in the study area are directly affected during major flood periods. No flood-related deaths are known to have occurred, but a serious threat to life and limb is always present during flood periods due to flooded residences and the related potential for electrical shock and injurious falls and due to attempted movement over flooded thoroughfares. Other previously experienced and future threats to public health and safety include impediment of local traffic, vermin from flooded areas, contamination of private water supplies, damage to water supply distribution systems, damage to wastewater collection facilities, and increased disease vector production during a major flood. Isolation of areas by flood waters could also create hazards in terms of supplying emergency medical, fire and law enforcement services. The potential for a fuel spill in the vicinity of the conduit inlet is always present during major floods due to the possible dislocation of the numerous fuel storage tanks in that area.

FISH AND WILDLIFE

The Bassett Creek watershed contains ample resources for recreational and sport fishing. Fish populations vary from lake to lake due to the diversity and quality of habitat available. Four of the five major lakes in the watershed are known to provide bass, panfish and some northern pike angling. Bassett Creek, along with the smaller lakes and ponds, contains carp, bullheads, sunfish and a variety of minnows. The migration of rough fish from the Mississippi River into Bassett Creek and the lakes and ponds

throughout the watershed, provides undesirable competition for the more desirable game fish species. Certain rough fish species can cause excessive turbidity problems due to the bottom feeding habits. While the extent of the turbidity levels in the creek or lakes and ponds in the watershed which is attributable to rough fish is unknown, continued migration of rough fish can be expected to increase the problem in the future.

Due to the extensive urbanization of the watershed, wildlife habitat is limited. As urbanization continues, this habitat will be further reduced and the wildlife population will generally be limited to waterfowl, birds and smaller mammals and amphibians and reptiles. There is a need to maintain and enhance those areas which provide wildlife habitat.

EXISTING PROJECTS

There are no existing Federal flood control projects located in the Bassett Creek watershed. The fixed spillway lake level control dam on Medicine Lake restricts the outlet capacity of the lake and provides temporary storage of flood waters. A lake level control structure on Sweeney Lake and the downstream crossings restrict the discharge capacity to the main stem and provide temporary storage of flood waters. A weir and outlet pipe on Northwood Lake restricts the discharge on the North Branch of Bassett Creek and provides temporary storage of flood waters. The purpose of these control structures is to maintain the normal lake levels during non-flood periods.

The existing channel crossings of Bassett Creek restrict flood flows and provide substantial inundation storage which significantly reduces the major flood peaks. The locations of significant areas of existing inundation storage are the Brookview Community Golf Course, Bassett Creek Park, Rice Lake and Theodore Wirth Park.

In Minneapolis, a 1.5 mile underground conduit serves as the outlet for the entire Bassett Creek watershed. Bassett Creek enters the conduit

near Second Avenue North and Dupont Avenue North and outfalls from the conduit into the Mississippi River above the Upper St. Anthony Lock and Dam near River Mile 855. As urbanization progressed along the creek in Minneapolis, the conduit was constructed in a piece-meal fashion from the Mississippi River to its existing inlet. Portions of the tunnel were constructed prior to 1900 and its cross-sectional area changes many times throughout its length, restricting the discharge capacity and providing obstructions for the accumulation of debris. The top of the tunnel inlet is well above the surrounding low areas and in order to flow full, the surrounding commercial and industrial development must be flooded. Only small flows can be carried by the existing conduit without inundating the surrounding commercial and industrial development. The existing conduit is in a state of general disrepair. In the concrete portions of the tunnel, there are several areas where the reinforcing steel has been exposed by the deterioration of the concrete surfaces. Where the conduit is constructed of sandstone block, the mortar joints have deteriorated. Failure of any section of the conduit during a flood or the accumulation of debris would further reduce the discharge capacity of the conduit, causing catastrophic flooding in the area of the inlet.

IMPROVEMENTS DESIRED

Public meetings were held in many of the municipalities within the Bassett Creek watershed during the preliminary Flood Control Feasibility Study to inform the public of the flood potential in the watershed, to review the options available for flood control, and to discuss the needs and desires of the people. Suggested solutions to the flood problem included a moratorium on future building in the flood plain and removal of all existing buildings in the flood plain, diversion of flood flows through Birch Pond to Cedar Lake, and Sweeney Lake, increased flood storage on Medicine Lake, cooperative drainage facilities with those proposed by the Minnesota Highway Department, and deep bedrock tunnels. The possibility of providing an open channel to the Mississippi River in place of the existing conduit was also suggested by local interests. The City of Minneapolis has initiated a study to review existing land use in the area of the existing conduit to determine if an open channel in this area would enhance a redevelopment plan.

It was suggested that consideration be given to the use of flood plain areas for recreational purposes. Because of the lack of trails and hiking areas along the creek in Minneapolis, it was also suggested that enough area be provided along an open channel through Minneapolis for walkways and other leisure activities. Residents in Golden Valley indicated that temporary flood storage on existing public property such as parks and golf courses would provide for the multiple use of those properties and would generally be acceptable. Local interests generally indicated that channel modifications and realignments are unacceptable and, wherever possible, the creek should be left in its existing state.

Public information workshops were held in eight of the nine municipalities within the Bassett Creek watershed during this study to inform the public of the options available for flood control and to discuss the needs and desires of the people. The comments and concerns of the citizens who attended these workshop meetings on features in various flood control alternative plans has helped to identify those flood control features which are compatible with the desires of the people of the watershed. These local interests indicated that the removal of homes which are currently within the flood plain should be avoided whenever possible. In addition, local interests expressed concern regarding the erosion potential of the creek throughout the watershed and expressed the need for improving the water quality of the creek, the need for clearing debris and rubbish from the creek and its banks and the need for orderly maintenance of the creek corridor. Local interests objected to any plan that would impair the aesthetics of the creek.

The needs of the watershed with regard to water supply and water quality problems are being considered under programs of other Federal, state, county and local governmental agencies as well as the Bassett Creek Flood Control Commission. This report concentrates on meeting the flood control and associated needs, including recreation and fish and wildlife.

PLAN FORMULATION

Plan formulation involves the identification and development of various flood control measures into viable plans, evaluating and screening of plans and the eventual development of a comprehensive plan. The basic objective of plan formulation studies involves development of a plan which will meet the flood control needs of the Bassett Creek watershed recognizing water and related land resource needs in the watershed.

Alternatives are developed using a list of defined planning objectives. The list serves as a guideline for the development of alternatives which are capable of satisfying some or all of these objectives. The specific planning objectives are components of the two national planning objectives of national economic development and environmental quality. In the study of flood and related problems in the Bassett Creek watershed, the following specific planning objectives have been identified:

- a. Any plan developed must preserve to the maximum extent possible the quality of the stream development through the watershed and must be coordinated with local beautification planning.
- b. The plan must provide flood damage reduction or compensation for losses to a degree acceptable to the people being protection. Protection from a one percent chance flood is considered the minimum degree of protection acceptable.
- c. The plan must be socially acceptable to the people being protected and must be acceptable to the local sponsor.
- d. The plan must enhance the economic welfare of the local people and add to their security and social well-being.

POSSIBLE SOLUTIONS

The solutions considered in this study to meet water and related land resource problems and needs in the Bassett Creek watershed, particularly for reduction of flood damages, were separated into three principal categories: nonstructural measures including no action or maintaining the base condition of the watershed, structural measures, and possible solutions involving combinations of nonstructural and structural measures. The extent of study given to each potential solution was established by evaluating each for its physical, political, financial, technical, institutional, economic, environmental, and social feasibility. Potential solutions meeting these general guidelines were compared with other potential solutions to assure a coordinated watershed-wide plan. Structural flood control measures were considered to supplement or complement nonstructural measures.

ALTERNATIVE SOLUTIONS FOR FLOOD CONTROL

Various nonstructural and structural flood control measures could reduce the potential for flood damage in the Bassett Creek watershed. Nonstructural measures include: no action--maintain base condition, permanent flood plain evacuation as a supplement to the base condition, and flood proofing and partial evacuation as a supplement to the base condition. Structural flood control measures for the watershed include: combinations of flood storage, channel modification and diversions upstream of Irving Avenue. In addition, structural measures for the outlet reach from the Mississippi River to Irving Avenue include: repair of the existing conduit, a new conduit, and an open channel.

Generally, the reduction of potential flood damages along Bassett Creek using structural measures required that a combination of specific structural features be used within a particular reach of the creek because of the urban nature of the creek and the development patterns along the creek. Therefore, the structural measures are designated according to

their principal structural feature for ease of reference. The nonstructural and structural measures considered are described briefly in the following paragraphs.

NONSTRUCTURAL ALTERNATIVES

NO ACTION--MAINTAIN BASE CONDITION (Alternate 1)

Maintaining the base condition would consist of taking no additional nonstructural or structural action to alleviate flood problems. The base condition for the Bassett Creek watershed consists of a flood forecasting-flood warning system available through the National Weather Service and reliance on emergency flood protection measures, floodplain regulations as required under Federal and State law and flood insurance available under Federal programs.

Maintaining the base condition or recommending no action be taken to alleviate flood problems would not burden the local interests and the Federal Government with the additional financial costs associated with other alternatives. Flood insurance will compensate property owners for damage to existing development in the floodplain and floodplain regulations will control future development of the floodplain and eliminate damage to future development. Generally, flood forecasting and flood warning systems do not provide ample time to construct emergency protective measures for existing development in the floodplain. Average annual flood damages of approximately \$767,900 would remain as a severe social and economic burden. Thus, with the existing base conditions, flood prone development would remain and recurring flood hazards would continue to cause economic losses and threaten the health, safety and social well-being of the people. In addition, the large commercial and industrial area in Minneapolis, which is located in the proximity of the entrance to the existing 1.5 mile conduit, would continue to be subject to possible catastrophic flooding in the event of a failure of any section of the existing conduit during a large flood or the accumulation of debris which would reduce the discharge capacity of the conduit. If debris accumulation or failure of any section of the existing conduit resulted

in a 50% reduction in the discharge capacity during a 100-year flood event, the flood level would be increased by approximately 6 feet and more than 250 acres of developed area would be inundated. In addition to public properties and utilities, more than 450 residential dwellings and more than 80 industries would be flooded. The resulting flood damages would be expected to be in excess of \$8 million.

PERMANENT FLOOD PLAIN EVACUATION (Alternate 2)

Permanent evacuation of all damageable flood prone structures from the developed flood plain areas in the Bassett Creek watershed would involve acquisition of lands by purchase, removal and relocation of improvements, evacuation and resettlement of the population, and management and permanent conversion of the lands to uses less susceptible to flood damage. Approximately 222 homes and 18 businesses are currently located within the 100-year flood plain in the Bassett Creek watershed. All of these homes and about 950 persons living in them would have to be relocated. Most of the industries and businesses in the flood plain area cannot be practically or economically moved because of their large size. Estimated tangible first costs for evacuating existing flood prone structures would be approximately \$47,856,000 with an average annual benefit of \$674,100. The benefit-cost ratio of this plan is 0.23, making the plan economically unfeasible. In addition, this plan would not provide protection for the development near the conduit entrance which would be subject to flooding as a result of blockage of the existing conduit by debris or failure of the existing conduit during a major flood.

FLOOD PROOFING - PARTIAL EVACUATION (Alternate 3)

Flood proofing is a combination of structural changes and adjustments to properties subject to flooding primarily for reduction or elimination of flood damages. Although it is most simply and economically applied to new construction, flood proofing is also applicable to some existing facilities. Individual dwelling units could be flood proofed by installing drain fields, permanently closing low openings, installing

check valves and filling around former walk-out basements. Care would have to be taken to assure that residences and businesses to be flood proofed would not become isolated during major floods. This alternative would provide for the flood proofing of all suitable structures within the 100-year flood plain and evacuating all others. The depth of flooding was used to determine whether a structure could be flood proofed or would have to be evacuated. All buildings which have less than two feet of first floor flooding from the 100-year flood would be flood proofed if access to them could be provided. All other flood prone structures would be evacuated. Using these criteria, 222 homes and 18 businesses would be either flood proofed or evacuated. The estimated first cost for flood proofing and partial evacuation would exceed \$26,346,000 and the benefits to cost ratio would be 0.41. This plan would not provide protection for the development near the conduit entrance which would be subject to flooding by blockage of the existing conduit by debris or failure of the existing conduit during a major flood.

STRUCTURAL ALTERNATIVES

Structural measures applicable to flood damage reduction in the Bassett Creek watershed involve combinations of three principal alternative flood control features because of the urban nature of the watershed and development patterns along the creek. These three main categories are channel modification, flood storage and diversion. In those areas where there is little or no existing development in the flood plain, maintaining the base condition is the most cost effective method of providing protection against future flood damage. These areas would include Plymouth Creek upstream of Medicine Lake, the North Branch of Bassett Creek upstream of Louisiana Avenue North and the Sweeney Lake Branch of Bassett Creek.

Combinations of the three main categories of structural flood control measures are applicable to the Bassett Creek watershed, however, in the reach from the Mississippi River to Irving Avenue, other structural alternatives were investigated regarding the outlet for Bassett Creek.

The outlet alternatives fall into three basic categories: repair of the existing conduit, a new conduit and an open channel. Several routes for a new outlet conduit for Bassett Creek were reviewed, some of which would cooperatively utilize drainage facilities with those proposed by the Minnesota Highway Department to provide drainage for the proposed Interstate 94 and Third Avenue highway distributor. In accordance with Minnesota Highway Department policy, the cost of these combined drainage facilities would be shared with the Highway Department based on peak flow contributions. To some degree, the selection and coordination of one of these alternative routes depends on the alternative selected by the Minnesota Highway Department to provide drainage from the proposed Interstate 94 and Third Avenue highway distributor and their proposed construction schedules. The Minnesota Highway Department has recommended that a tunnel beginning at the intersection of 12th Avenue and 4th Street, following an alignment along 2nd Street and outletting in the middle pool below St. Anthony Falls be constructed to provide drainage for the proposed Interstate Highway 94 and that Bassett Creek be incorporated into the drainage system for the 3rd Avenue distributor entering the tunnel at 3rd Avenue North.¹ The recommended alternative has the lowest total cost and would result in fewer complications with construction schedules for the cooperative and non-cooperative portions of the tunnels. At the present time, the Third Avenue highway distributor is scheduled for construction in the spring of 1977, while the construction schedule for Interstate 94 has been set for the spring or summer of 1977.

Another alternative for providing a new conduit in the outlet reach of Bassett Creek would be to construct a conduit entirely and at the complete expense of the flood control project. This alternative would not utilize combined drainage facilities and, therefore, the entire burden of the construction cost would be placed on the flood control project.

¹Preliminary Design Report, Drainage Study on Interstate 94 in Minneapolis, Minnesota Highway Department, September 1975.

Several open channel alternatives were identified for the reach of Bassett Creek from the Mississippi River to Irving Avenue. The most acceptable open channel alternative would provide a broad open space corridor from approximately the inlet to the existing conduit to the Mississippi River through which Bassett Creek would flow.

In order to facilitate the discussion of the flood control alternatives for the watershed as a whole, combinations of the three basic flood control measures of flood storage, channel modification and diversion are discussed for each of the outlet alternatives for Bassett Creek in the reach from the Mississippi River to Irving Avenue. Following that discussion, the outlet alternatives for the reach from the Mississippi River to Irving Avenue are discussed in combination with flood storage and non-structural alternatives.

FLOOD STORAGE AND CHANNEL MODIFICATION
WITH REPAIR OF EXISTING CONDUIT (Alternate 4-A)

This alternate would generally consist of modifying the channel, thus improving its discharge capacity, within limits imposed by development along the creek and repairing the existing conduit. The channel would be enlarged and straightened to the extent feasible and necessary with a minimum encroachment on private property. Generally, the existing temporary flood water storage provided by existing restrictive channel crossings upstream of the reaches requiring channel modification would be sufficient to lower the discharge to a level which could be conveyed by the modified channels. The first cost of this plan would be \$12,218,000 with an average annual cost of \$750,300 and the benefit-cost ratio would be 0.89.

FLOOD STORAGE AND CHANNEL MODIFICATION WITH A NEW
CONDUIT IN NON-HIGHWAY RIGHT-OF-WAY (Alternate 4-B)

This plan consists of the channel modification alternative (Alternate 4-A) for the upper Bassett Creek watershed except for the reach from the Mississippi River to Irving Avenue. In this reach, the new conduit would be constructed in the right-of-way of city streets where possible or through industrial areas. This new conduit would replace the existing conduit which does not provide adequate discharge capacity for 100-year flood protection and which is in need of extensive repair to extend its useful life. The first cost of this plan would be \$15,425,000 with an average annual cost of \$947,300 and the benefit-cost ratio would be 0.71.

FLOOD STORAGE AND CHANNEL MODIFICATION WITH NEW
CONDUIT IN THIRD AVENUE DISTRIBUTOR RIGHT-OF-WAY
AND DEEP TUNNEL (Alternate 4-C)

This plan consists of the channel modification alternative (Alternate 4-A) for the upper Bassett Creek watershed and the construction of a new conduit for the reach from the Mississippi River to Irving

Avenue. The new conduit would be constructed in city street right-of-way and in the right-of-way of the proposed Third Avenue highway distributor and would connect to a proposed highway drainage tunnel at Third Avenue and Washington Avenue, which would outfall into the Mississippi River below St. Anthony Falls. This new conduit would replace the existing conduit which does not provide adequate discharge capacity for 100-year flood protection and is in need of extensive repair to extend its useful life. The first cost of this plan would be \$10,898,000 with an average annual cost of \$669,300 and the benefit-cost ratio would be 1.00.

FLOOD STORAGE AND CHANNEL MODIFICATION WITH A NEW
CONDUIT - INTERSTATE 94 RIGHT-OF-WAY AND
DEEP TUNNEL (Alternate 4-D)

This plan consists of the flood storage and channel modification alternative (Alternate 4-A) for the Bassett Creek watershed except for the reach from the Mississippi River to Irving Avenue. In this reach, a new conduit would be constructed in the right-of-way of the proposed Interstate 94 and would connect to a proposed highway drainage tunnel at 12th Avenue North and Washington Avenue, which would outfall into the Mississippi River below St. Anthony Falls. This new conduit would replace the existing conduit. The first cost of this plan would be \$11,938,000 with an average annual cost of \$733,100 and the benefit-cost ratio would be 0.91.

FLOOD STORAGE AND CHANNEL MODIFICATION WITH AN
OPEN SPACE - OPEN CHANNEL CORRIDOR TO THE
MISSISSIPPI RIVER (Alternate 4-E)

This plan would consist of the flood storage and channel modification alternative (Alternate 4-A) for the Bassett Creek watershed except for the reach from the Mississippi River to Irving Avenue. In this reach, rather than repair the existing conduit or construct a new conduit, an open channel with substantial open space on either side of the channel

would provide the new outlet for Bassett Creek. This proposed open channel would replace the existing conduit which does not provide adequate discharge capacity for 100-year flood protection and which is in need of extensive repair to extend its useful life.

The City of Minneapolis has initiated a study to review possible redevelopment alternatives in this portion of north Minneapolis. Although the study has not been completed, it is anticipated that if the open space and open channel corridor were included as a part of the redevelopment alternatives for this area, substantial recreational and land enhancement benefits could be realized by construction of the plan. However, the magnitude of the recreational benefits and land enhancement benefits cannot be evaluated until more information regarding the proposed redevelopment of the area including changes in land use and population densities are known and, therefore, these potential benefits cannot be reflected in the benefit to cost ratio.

The first cost of this plan would be \$62,145,000 with an average annual cost of \$3,816,300 and the benefit-cost ratio would be 0.18 with only flood control benefits assuming no increased recreational benefits or land enhancement benefits due to future redevelopment of the area.

FLOOD STORAGE AND DIVERSION WITH REPAIR OF EXISTING CONDUIT (Alternate 5-A)

This plan consists of a flood storage and diversion alternative for the upper Bassett Creek watershed and repair of the existing conduit (Alternate 4-A) for the reach from the Mississippi River to Irving Avenue. This plan would utilize potential flood water storage areas in the watershed or diversion in order to lower discharges in the channel and minimize the need for channel modification. The first cost of this plan would be \$14,187,000 with an average annual cost of \$871,200 and the benefit-cost ratio would be 0.76.

FLOOD STORAGE AND DIVERSION WITH A NEW CONDUIT IN NON-HIGHWAY RIGHT-OF-WAY (Alternate 5-B)

This plan consists of the flood storage and diversion alternative (Alternate 5-A) for the upper Bassett Creek watershed and a new conduit

(Alternate 4-B) for the reach from the Mississippi River to Irving Avenue. The first cost of this plan would be \$17,394,000 with an average annual cost of \$1,068,200 and a benefit cost ratio of 0.63.

FLOOD STORAGE AND DIVERSION WITH A NEW CONDUIT
IN THIRD AVENUE DISTRIBUTOR RIGHT-OF-WAY
AND DEEP TUNNEL (Alternate 5-C)

This plan consists of the flood storage and diversion alternative (Alternate 5-A) for the upper Bassett Creek watershed and a new conduit (Alternate 4-C) for the reach from the Mississippi River to Irving Avenue. The first cost of this plan would be \$12,868,000 with an average annual cost of \$790,200 and a benefit-cost ratio of 0.84.

FLOOD STORAGE AND DIVERSION WITH A NEW CONDUIT -
INTERSTATE 94 RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 5-D)

This plan consists of the flood storage and diversion alternative (Alternate 5-A) for the upper Bassett Creek watershed and a new conduit (Alternate 4-D) for the reach from the Mississippi River to Irving Avenue. The first cost of this plan would be \$13,907,000 with an average annual cost of \$854,000 and a benefit-cost ratio of 0.78.

FLOOD STORAGE AND DIVERSION WITH AN OPEN SPACE -
OPEN CHANNEL CORRIDOR TO THE MISSISSIPPI RIVER
(Alternate 5-E)

This plan would consist of the flood storage and diversion alternative (Alternate 5-A) for the upper Bassett Creek watershed and an open space-open channel corridor (Alternate 4-E) for the reach from the Mississippi River to Irving Avenue. The first cost of this plan would be \$64,114,000 with an average annual cost of \$3,937,200 and a benefit-cost ratio of 0.17.

COMBINATIONS OF NONSTRUCTURAL AND STRUCTURAL ALTERNATIVES

FLOOD STORAGE AND FLOOD PROOFING WITH REPAIR
OF EXISTING CONDUIT (Alternate 6-A)

This plan consists of flood storage in combination with flood proofing for the Bassett Creek watershed and repair of the existing conduit

(Alternate 4-A) in the reach from the Mississippi River to Irving Avenue. This plan would utilize potential flood water storage areas in the watershed in order to lower discharges in the channel. Residences which cannot be protected by flood storage alone would be flood proofed to minimize the need for channel modifications and diversions. The first cost of this plan would be \$11,031,000 with an average annual cost of \$677,400 and a benefit-cost ratio of 0.98.

FLOOD STORAGE AND FLOOD PROOFING WITH A NEW CONDUIT
IN NON-HIGHWAY RIGHT-OF-WAY (Alternate 6-B)

This plan generally consists of the flood storage and flood proofing alternative (Alternate 6-A) for the upper Bassett Creek watershed and a new conduit (Alternate 4-B) in the reach from the Mississippi River to Irving Avenue. The first cost of this plan would be \$13,968,000 with an average annual cost of \$857,800 and a benefit-cost ratio of 0.78.

FLOOD STORAGE AND FLOOD PROOFING WITH NEW CONDUIT
IN THIRD AVENUE DISTRIBUTOR RIGHT-OF-WAY AND
DEEP TUNNEL (Alternate 6-C)

This plan generally consists of the flood storage and flood proofing (Alternate 6-A) for the upper Bassett Creek watershed and a new conduit (Alternate 4-C) in the reach from the Mississippi River to Irving Avenue. The first cost of this plan would be \$9,439,000 with an average annual cost of \$579,655 and a benefit-cost ratio of 1.14.

FLOOD STORAGE AND FLOOD PROOFING WITH A NEW CONDUIT -
INTERSTATE 94 RIGHT-OF-WAY AND DEEP TUNNEL (Alternate 6-D)

This plan generally consists of the flood storage and flood proofing alternative (Alternate 6-A) for the upper Bassett Creek watershed and a new conduit (Alternate 4-D) for the reach from the Mississippi River to Irving Avenue. The first cost of this plan would

be \$10,751,000 with an average annual cost of \$660,200 and a benefit-cost ratio of 1.01.

FLOOD STORAGE AND FLOOD PROOFING WITH AN OPEN SPACE - OPEN CHANNEL CORRIDOR TO THE MISSISSIPPI RIVER (Alternate 6-E)

This plan generally consists of the flood proofing and partial evacuation alternative (Alternate 6-A) in the upper Bassett Creek watershed and an open space-open channel corridor (Alternate 4-E) for the reach from the Mississippi River to Irving Avenue. The first cost of this plan would be \$60,958,000 with an average annual cost of \$3,743,000 and a benefit-cost ratio of 0.18.

OTHER ALTERNATIVES CONSIDERED

Several additional plans were considered for various reaches of the creek, but were rejected because they did not provide 100-year flood protection or because they were economically, socially, or environmentally undesirable. Enlargement of the channel throughout the watershed, without reliance on existing flood storage sites would require the replacement of most of the existing channel crossings and extensive relocation of existing development to construct the enlarged channel. Flood barriers were also considered as a flood control measure, however, they would be aesthetically displeasing in residential areas and would require extensive relocation of existing development to construct interior drainage systems.

In the reach from the Mississippi River to Theodore Wirth Park, several alternates were considered including; a deep tunnel from the existing conduit entrance to the river, a diversion to the drainage facilities for Interstate Highway 35W, a diversion to Birch Pond and then to Brownie Lake and a conduit under Plymouth Avenue from Theodore Wirth Park to the Mississippi River. Several alternative routes for an open channel with varying cross-sections were also reviewed.

In the reach from Theodore Wirth Park to Medicine Lake, several diversion plans from various points on the creek to Sweeney Lake were considered. Upstream of Medicine Lake, a system of temporary storage ponds was reviewed, however, this alternative is high unfavorable economically. Along the Sweeney Lake Branch, several relocations of the existing channel were considered and along the North Branch, several alternate methods of diverting flood flows were considered.

The alternative of increasing the temporary flood storage in Theodore Wirth Park or not increasing the existing flood level and its effect on downstream areas was evaluated extensively. Without increased flood storage in Theodore Wirth Golf Course, the flood walls downstream of Glenwood Avenue must be higher and the size of the cooperative conduit must be increased. With the increased conduit size, the storage area at the conduit entrance can be reduced slightly, however, the cost of alternatives without storage at Theodore Wirth Golf Course would be about \$1 million higher than alternatives with storage in the golf course.

The cooperative conduit alternatives with varying amounts of storage volume at the conduit entrance were also reviewed. Without storage at the conduit entrance, the capacity of the cooperative conduit would have to be approximately doubled because inflow from Bassett Creek and inflow from highway drainage areas will coincide. Alternatives without storage at the conduit entrance would cost approximately \$3 million more than alternatives with storage at the conduit entrance. The most economical alternative requires approximately 90 acre-feet of storage volume at the conduit entrance.

EVALUATION OF ALTERNATIVES

Possible alternative solutions were identified based on the ability of each to satisfy the basic objective of wise water and related land resource management for both short- and long-term needs of the Bassett Creek watershed. The overriding objective guiding further development of the alternatives is the ability to satisfy the need for flood damage

reduction or compensation for which the study was authorized. The environmental, economic, and social well-being objectives are also taken into consideration for guiding further development of the alternatives where they are consistent with the ability to satisfy the need for flood damage reduction.

All alternatives which offer an acceptable degree of flood damage reduction or compensation for incurred flood damages would enhance the economic welfare of the citizens of the Bassett Creek watershed. The no action--maintain the base condition alternative consisting of flood plain regulation and flood forecasting-flood warning would lessen future flood damages and flood insurance would reimburse through compensation flood damage losses to existing development in the flood plain. The existing flood insurance premiums are heavily subsidized by the Federal government making this insurance economically attractive to flood plain residents. However, in the future, as flood insurance rate studies are completed in the municipalities within the watershed, flood insurance premiums for new development will be based on actuarial rates. Flood plain regulations will control future development and will eliminate flood damage to future development. Flood forecasting and flood warning systems generally do not provide adequate time to construct emergency flood protection measures for existing development.

Permanent evacuation of the flood plain would give immediate protection from flood damages and when combined with the base condition, would reduce future flood damages. However, the high economic cost and the social disruption resulting from this plan make this plan extremely impractical and undesirable in the Bassett Creek watershed. However, evacuation warrants further consideration for individual homes or businesses which cannot be economically protected by other measures.

The flood proofing and partial evacuation alternative would tend to enhance the local economy by reducing future flood damages in flood prone areas within the watershed. However, those residents being relocated might disagree with this conclusion. The cost to the local sponsor may not be offset by flood damage reduction with this plan due to the long-term effects of reduced property tax base. While this alternative satisfies the specific objective of flood damage reduction, the social disruption due to the partial evacuation, the disruption to transportation and the potential dangers to health and safety make this plan undesirable and unacceptable for the Bassett Creek watershed. However, in certain reaches of Bassett Creek and its tributaries where existing development is not isolated during major floods and is not subject to excessive inundation, flood proofing and partial evacuation as a supplement to the base condition or in combination with structural alternatives provides a viable flood damage reduction alternative.

The effects of the structural alternatives on the quality and aesthetics of Bassett Creek varies considerably. The flood storage and channel modification alternative would have severe adverse effects on the quality and aesthetics of Bassett Creek. Channel modifications would necessitate the removal of a large number of mature trees and the understory vegetation growing along those reaches of Bassett Creek. While restoration measures such as landscaping and replanting would minimize the long-term adverse aesthetic effects due to channel modification, the short-term aesthetic effects would have a significant adverse effect on the residential properties abutting the creek through most of the reaches requiring channel modification. In addition, significant short-term effects on the biological system in the creek bed and overbank would occur with construction of the channel modification. The biological diversity of these areas would be significantly disturbed or destroyed as a result of the construction of the channel modifications. In the long-term, the biological systems which would be reestablished along the creek would differ significantly from those which currently exist in those areas. The aesthetics of the creek corridor would be significantly changed in the long-term due to the removal of the

natural meanders, oxbows and backwater areas which currently exist along the creek. During the construction of the channel modification, the erosion of exposed soils and the subsequent sedimentation would have a severe adverse effect on the water quality and aesthetic value of the creek in the reaches downstream of the channel modifications.

The residents of the watershed have indicated that extensive channel modifications are unacceptable due to the environmental and aesthetic effects. In addition, as shown on Table 1, there are several alternative plans more economically feasible than the flood storage and channel modification alternative.

The flood storage and diversion alternative would significantly reduce the adverse effects on the quality and aesthetics of Bassett Creek when compared to channel modification. The areas subjected to the short-term impacts of project construction are significantly smaller for the flood storage and diversion alternative than for the flood storage and channel modification alternative since it would require the disruption of the stream channel and overbank areas only at the

TABLE 1. ECONOMIC IMPACT OF FLOOD DAMAGE REDUCTION ALTERNATIVES FOR WISE 1 WATER CONTROL

	Alternate 1 No Action-Maintain Base Condition	Alternate 2 Permanent Flood Plain Evacuation	Alternate 3 Flood Proofing and Partial Evacuation	Alternate 4-A Flood Storage- Channel Modification Repair Existing Conduit	Alternate 4-B Flood Storage- Channel Modification New Conduit Non-Highway	Alternate 4-C Flood Storage- Channel Modification New Conduit New Conduit-1st Avenue	Alternate 4-D Flood Storage- Channel Modification New Conduit-Interstate 94	Alternate 4-E Flood Storage- Channel Modification Open Space- Open Channel Corridor	Alternate 5-A Flood Storage- Channel Modification Repair Existing Conduit
Total First Cost	0	47,854,000	26,346,000	12,218,000	15,425,000	10,000,000	11,938,000	62,145,000	14,187,000
Federal First Cost	0	38,285,000	21,077,000	8,674,000	11,208,000	8,038,000	8,444,000	9,810,000	11,038,000
Non-Federal First Cost	0	9,571,000	5,269,000	3,544,000	4,217,000	2,862,000	3,594,000	52,335,000	3,159,000
Total Average Annual Cost	?	2,938,800	1,617,900	750,300	947,300	689,300	733,100	3,816,300	871,200
Federal Average Annual Cost	?	2,350,800	1,293,600	515,700	688,400	493,100	530,400	602,800	676,600
Non-Federal Average Annual Cost	?	588,000	324,300	234,600	258,900	176,200	202,700	3,213,500	194,600
Non-Federal Maintenance	0	0	0	11,000	10,000	10,000	10,000	12,000	14,000
Average Annual Benefits	?	681,500	663,800	677,200	677,200	677,200	677,200	677,200	674,800
Net Average Annual Benefits	?	-2,255,300	-954,100	-86,100	-280,100	-2,100	-85,900	-3,151,100	-210,400
Benefit-Cost Ratio	?	0.23	0.41	0.89	0.71	1.00	0.91	0.18	0.76

	Alternate 5-B Flood Storage- Channel Modification New Conduit Non-Highway	Alternate 5-C Flood Storage- Channel Modification New Conduit-1st Avenue	Alternate 5-D Flood Storage- Channel Modification New Conduit-Interstate 94	Alternate 5-E Flood Storage- Channel Modification Open Channel Corridor	Alternate 6-A Flood Storage- Channel Modification Repair Existing Conduit	Alternate 6-B Flood Storage- Channel Modification New Conduit Non-Highway	Alternate 6-C Flood Storage- Channel Modification New Conduit-1st Avenue	Alternate 6-D Flood Storage- Channel Modification New Conduit-Interstate 94	Alternate 6-E Flood Storage- Channel Modification Open Channel Corridor
Total First Cost	17,192,000	12,868,000	13,907,000	64,114,000	44,031,000	13,468,000	9,439,000	10,751,000	60,938,000
Federal First Cost	13,962,000	10,191,000	10,998,000	12,184,000	8,007,000	10,130,000	6,723,000	7,977,000	9,143,000
Non-Federal First Cost	3,230,000	2,677,000	2,909,000	51,930,000	3,024,000	3,338,000	2,716,000	2,774,000	51,815,000
Total Average Annual Cost	1,068,200	790,200	954,000	3,937,200	677,400	57,800	579,700	660,200	3,743,000
Federal Average Annual Cost	832,300	637,900	675,400	247,100	482,000	634,500	413,600	489,700	561,400
Non-Federal Average Annual Cost	235,900	152,300	178,600	3,190,100	185,400	221,300	166,100	170,500	3,181,600
Non-Federal Maintenance	11,000	11,000	11,000	11,000	13,000	10,000	10,000	10,000	12,000
Average Annual Benefits	674,800	674,800	674,800	674,800	674,000	674,000	674,000	674,000	674,000
Net Average Annual Benefits	-608,600	-126,400	-190,200	-1,275,400	-16,400	-191,800	84,300	3,800	-3,081,000
Benefit-Cost Ratio	0.61	0.84	0.78	0.17	0.94	0.78	1.14	1.01	0.18

Costs do not include lands, upping, planting and seeding, beautification, rustication or recreation facilities.

locations of the flood storage control structures and where channel crossings are being replaced. The flood control structures would consist of earth embankments similar to those at many of the street crossings of the channel. These earth embankments would be seeded and planted to provide aesthetically pleasing structures.

In addition, the diversion alternative would have short-term adverse effects on the quality and aesthetics along the route of the various diversions. The Jersey and 32nd Avenue diversion along the North Branch and the Culver Road diversion to Rice Lake would require substantial excavation along those residential streets to install the diversion interceptors. During the construction of those interceptors, the quality and aesthetics of the residential areas along these routes would suffer significant adverse effects until the construction and rehabilitation of the area was complete. The construction of these diversions would cause significant social disruption of these residential areas although wise construction practices could minimize adverse effects.

The diversion of the creek at Glenwood Avenue would have significant short-term adverse effects along the route of that diversion. The existing natural vegetation along much of this route would have to be removed for the construction of the diversion. The existing wildlife habitat along this diversion route would be temporarily disrupted during construction and during that period in which the area would be returning to its natural state. Although biologically this area is not particularly unique, the biological systems would be subject to considerable disruption during construction and for a period of time following the construction of this diversion. Generally, the flood storage and diversion alternative is an economically and environmentally acceptable alternative for flood damage reduction.

The flood storage and flood proofing alternative would also significantly reduce the adverse effects on the quality and aesthetics of Bassett Creek when compared to channel modification. This alternative is similar to the flood storage and diversion alternative with respect to

disruption of the stream channel. Although this alternative would not cause significant adverse effects on the aesthetics or quality of the creek, those residents being flood proofed or evacuated would suffer considerable disruption until flood proofing measures were completed or until they were relocated. Generally the flood storage and flood proofing alternative is an economically, environmentally, and socially acceptable flood control alternative.

All of the outlet alternatives offer an acceptable degree of flood damage reduction or compensation for incurred flood damages and enhance the economic or environmental welfare of the citizens of the Bassett Creek watershed. The repair of the existing conduit and all of the new conduit alternatives are comparable with respect to their environmental and social effects and generally the alternatives will have an insignificant effect on the quality and aesthetics of the existing stream environment. Economically, the outlet alternatives do differ slightly as shown on Table 1. The new conduit alternative along the Third Avenue distributor constructed in cooperation with the Minnesota Highway Department is the most cost effective. The rank of the other outlet alternatives with respect to their economic feasibility would be: new conduit along Highway 94 to deep tunnel in cooperation with Minnesota Highway Department; repair of the existing conduit and; new conduit in non-highway right-of-way.

The open space-open channel corridor alternative as a replacement for the existing conduit would significantly enhance the quality and aesthetics of the stream environment in the City of Minneapolis. The open space created would also result in land enhancement and recreational benefits in conjunction with the proposed redevelopment plan in the area. The magnitude of these benefits, however, cannot be quantified until more information regarding possible land use changes and population densities have been identified. The open space-open channel corridor outlet alternative is the most environmentally beneficial and is the most socially acceptable alternative to some of the people of the area.

ALTERNATIVES SELECTED FOR FURTHER ANALYSIS

Further development of any of the alternatives investigated must be based on evaluation of their contributions to the wise resource management for both short- and long-term needs of the Bassett Creek watershed. Their ability to satisfy the obvious needs for permanent flood damage reduction or compensation of incurred flood damages as well as their contributions to their specific plan formulation objectives are important considerations.

The nonstructural alternatives of permanent flood plain evacuation and flood proofing and partial evacuation by themselves are generally socially unacceptable and are economically unfeasible and, therefore, do not warrant further consideration.

While no nonstructural alternative completely satisfies the specific objective of permanent flood damage reduction, certain nonstructural alternatives, when used to supplement structural flood control measures do provide practical solutions in certain reaches of the Bassett Creek watershed. The nonstructural plans which should be considered further as supplements to structural flood control measures are: 1) no action--maintain the base condition consisting of existing flood plain regulation, flood forecasting-flood warning and emergency protective measures and the availability of flood insurance for existing development as a datum from which other alternatives can be assessed and; 2) flood proofing and the evacuation of structures not suitable for flood proofing in areas which cannot be economically protected by other flood control measures.

All of the structural plans considered including channel modification, flood storage, diversion and the various outlet alternatives satisfy the specific objective of flood damage reduction. However, the various structural plans provide varying degrees of satisfaction to the other specific plan formulation objectives. Alternatives involving extensive channel modification are unacceptable to residents of the watershed and do not warrant further consideration. The repair of the existing

conduit and all of the new conduit alternatives are comparable with respect to the degree of protection provided and their effects on the quality and aesthetics of the stream environment. However, the new conduit alternative along the Third Avenue distributor constructed in cooperation with the Minnesota Highway Department is the most cost effective, and is therefore, the only new conduit alternative which warrants further consideration. The open space-open channel corridor outlet alternative is the most socially acceptable alternative to the people in the area and is the most environmentally beneficial outlet alternative. The open space-open channel outlet alternative must, therefore, be considered further.

Of the alternatives investigated, the following alternatives merit further consideration and the following table ranks these alternatives according to how well each would satisfy the specific planning objectives.

Nonstructural:

No action--maintain the base condition (flood plain regulation, flood forecasting-flood warning and emergency protection and flood insurance).
(Alternate 1)

Structural:

Flood storage and diversion with a new conduit in Third Avenue distributor right-of-way and deep tunnel. (Alternate 5-C)

Flood storage and diversion with an open space-open channel corridor to the Mississippi River. (Alternate 5-E)

Combinations of Nonstructural and Structural:

Flood storage and flood proofing - partial evacuation with a new conduit in the Third Avenue distributor right-of-way and deep tunnel.
(Alternate 6-C)

Flood storage and flood proofing - partial evacuation with an open space-open channel corridor to the Mississippi River. (Alternate 6-E)

RANKING OF ALTERNATIVES

Specific Planning Objectives	High ←		Plan →		Low	
	Satisfaction Rating		Satisfaction Rating		Satisfaction Rating	
a. Preserve quality of stream environment.	No Action--Maintain Base Condition (Alternate 1)	Flood Storage and Flood Proofing - Partial Evacuation Open Channel Corridor (Alternate 6-E)	Flood Storage and Diversion - Open Channel Corridor (Alternate 5-E)	Flood Storage and Flood Proofing - Partial Evacuation New Conduit Along Third Avenue (Alternate 6-C)	Flood Storage and Diversion - New Conduit along Third Avenue (Alternate 5-C)	
b. Flood damage reduction or compensation of losses	Flood Storage and Diversion - Open Channel Corridor or New Conduit Along Third Avenue (Alternates 5-E and 5-C)	Flood Storage and Flood Proofing - Partial Evacuation Open Channel Corridor or New Conduit Along Third Avenue (Alternates 6-E and 6-C)	--	--	No Action--Maintain Base Condition (Alternate 1)	
c. Social acceptability	Flood Storage and Flood Proofing - Partial Evacuation New Conduit Along Third Avenue (Alternate 6-C)	Flood Storage and Diversion - New Conduit Along Third Avenue (Alternate 5-C)	Flood Storage and Flood Proofing - Partial Evacuation Open Channel Corridor (Alternate 6-E)	Flood Storage and Diversion - Open Channel Corridor (Alternate 5-E)	No Action--Maintain Base Condition (Alternate 1)	
d. Local economic welfare and security	Flood Storage and Flood Proofing - Partial Evacuation New Conduit Along Third Avenue (Alternate 6-C)	Flood Storage and Diversion - New Conduit Along Third Avenue (Alternate 5-C)	No Action--Maintain Base Condition (Alternate 1)	Flood Storage and Flood Proofing - Partial Evacuation Open Channel Corridor (Alternate 6-E)	Flood Storage and Diversion - Open Channel Corridor (Alternate 5-E)	

CONTRIBUTIONS OF ALTERNATIVES TO NATIONAL OBJECTIVES

Formulating plans that contribute to the national objectives of national economic development and environmental quality is important in water resource planning. To achieve a balanced plan which reflects society's dual preference for improving national economic efficiency while maintaining and enhancing the natural environment, current guidelines require that a plan emphasizing national economic efficiency and a plan emphasizing the environmental quality objective be developed and displayed. Through a series of trade-offs among Federal criteria and other societal preferences and trade-offs between the beneficial and adverse nature of impacts, the plan which contributes most to the national and local planning objectives is developed and further refined via the interactive planning process.

NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

The NED plan maximizes net economic benefits while addressing the range of planning objectives. National economic benefits are determined by measuring and analyzing the net value of increase in the output of goods and services derived from the plan. Therefore, using the economic criteria outlined earlier, all alternatives are analyzed based on their respective contributions to providing increased gains on the national economic efficiency. Table 1 compares the flood damage reduction benefits and associated costs for each of the alternatives. The flood storage and flood proofing - partial evacuation with a new conduit along the Third Avenue distributor and deep tunnel alternative (Alternate 6-C) has the highest net benefits and benefit-cost ratio and thus constitutes the national economic development plan.

ENVIRONMENTAL QUALITY (EQ) PLAN

The EQ plan addresses the planning objectives while emphasizing contributions to aesthetic, ecological and cultural values. Since the

alternatives chosen for further analysis were formulated primarily for the flood damage reduction objective, it is necessary to evaluate these alternatives in the context of enhancing environmental quality to develop the most acceptable environmental quality plan. Development of the environmental quality plan is based on the following criteria:

- a. Since alternatives were formulated based on satisfaction of environmental objectives and social well-being constraints, the alternative which will serve as a framework for the development of the environmental quality plan has already been evaluated.
- b. The selected framework environmental quality alternative is that alternative which is initially least environmentally disruptive and the most environmentally beneficial to the existing flood plain area.
- c. With the framework alternative selected, environmental enhancement measures and features to better fulfill the specific objectives are added incrementally to develop the most acceptable and environmentally beneficial plan.

An interdisciplinary team evaluated the plans for environmental quality including the beneficial and adverse contributions made by each alternative toward preserving, maintaining, restoring and enhancing significant environmental attributes of the study area. This interdisciplinary evaluation found the flood storage and flood proofing - partial evacuation with an open space-open channel corridor alternative (Alternate 6-E) to be among the most environmentally beneficial. Therefore, this alternative, with slight modification, is designated the framework environmental quality alternative.

The framework environmental quality alternative (Alternate 6-E) would result in some adverse social disruption effects due to evacuation and relocation of the existing residential and industrial development which lies along the route of the open space-open channel corridor. However, the framework environmental quality alternative will result in substantial offsetting beneficial environmental contributions. This alternative creates more open space in an urban commercial-industrial area. This open space improves the aesthetics and creates a passive recreation resource in this reach. The framework environmental quality alternative would result in land enhancement benefits when included as part of the redevelopment of this area. The recreational benefits and land enhancement cannot be quantified until more information regarding the proposed redevelopment of the area including changes in the land use and population densities are known. The City of Minneapolis has initiated a study to review possible redevelopment alternatives in this portion of north Minneapolis and although the study has not been completed, it is anticipated that the open space-open channel corridor will be included as part of the redevelopment alternatives for this area.

In that portion of the Bassett Creek watershed upstream of Irving Avenue, the interdisciplinary team determined that the flood storage and flood proofing - partial evacuation alternative with slight modification was the least environmentally disruptive. Flood storage minimizes the areas subject to construction during implementation of the project. Flood storage has minimum adverse effects on the fish and wildlife habitat throughout the watershed. The use of public lands and recreational open space areas makes multiple use of these lands in an urban area. Flood storage results in minimum adverse social disruption effects due to construction and implementation of the flood control project.

The interdisciplinary team identified several areas where slight modifications in the flood storage and flood proofing - partial evacuation alternative would better fulfill the environmental and social well-being criteria, be less environmentally disruptive or enhance environmental quality. Clearing and snagging would be eliminated in the reach from Bassett Creek Drive to Highway 100 to preserve the integrity of the existing aquatic and upland wildlife habitat in the Briarwood Bird Sanctuary and along the creek upstream of Minnaqua Avenue. Instead of clearing and snagging in this reach, nine additional homes would be flood proofed. To insure that the existing fish spawning characteristics of Medicine Lake will not be altered, the flood level would not be lowered. The existing outlet structure would be repaired to extend its useful life, however, the modification of the channel immediately downstream of the outlet structure would be eliminated. Instead of lowering the flood level on Medicine Lake, six homes would be flood proofed to reduce flood damage.

Other environmental enhancement measures were evaluated and identified by the interdisciplinary team for incorporation into the framework environmental quality alternative to develop the plan which best satisfies the national environmental quality objective. The specific environmental quality needs which could be preserved, maintained, restored or enhanced by inclusion of the measures in the framework environmental quality alternative include:

- a. The need for protection and enhancement of the aesthetic values.
- b. The need to enhance the recreational opportunities within the creek corridor.

While only plans incorporating structural measures can offer positive protection from flooding, these measures would adversely affect the view along the creek. In some areas restoration of existing aesthetic values following the construction of structural features would be sufficient, whereas, in other areas additional aesthetic enhancement is necessary. The beautification measures required include rustication of concrete structural features, additional landscaping, planting and seeding and general beautification of areas affected by the construction of structural features. These areas include the banks of the creek between Dupont and Glenwood, the flood wall and retaining wall just downstream of Glenwood Avenue, the Rice Lake area particularly where demolition debris is covered, the Bassett Creek Park area, and along the North Branch between Douglas Drive and Louisiana Avenue.

To enhance the recreational opportunities and further enhance the aesthetic quality of the environmental quality plan, approximately 17,000 lineal feet of paved bike path and walkway are included between Theodore Wirth Park and the Mississippi River along the creek. The proposed bike path and walkway would follow the creek along the existing corridor and along the proposed open space-open channel corridor. Numerous paved ramps leading to and from the proposed bike path and walkway would be provided at several key city streets and wherever the corridor lies adjacent to existing public use lands and facilities.

In summary, the environmental quality plan would include the features of the flood storage and flood proofing - partial evacuation with an open space-open corridor alternative (Alternate 6-E) with the following modifications:

- a. Eliminate clearing and snagging in the reach from Bassett Creek Drive to Highway 100 and flood proof nine additional homes in this reach to preserve the existing aquatic and upland wildlife habitat.

- b. Flood proof homes around Medicine Lake to preserve the existing fish spawning characteristics of the lake.
- c. Include approximately 17,000 lineal feet of asphalt bike path and walkway along the creek corridor from the Mississippi River to Theodore Wirth Park.
- d. Include extensive beautification measures in the area of all flood control features.

DEVELOPMENT OF THE SELECTED PLAN

The flood storage and flood proofing - partial evacuation with a new conduit along the Third Avenue distributor right-of-way and deep tunnel alternative (Alternate 6-C) is selected as the water and related land resource management alternative which would best satisfy all planning objectives both specific and national for the Bassett Creek watershed. Of the considered alternatives, it would provide 100-year flood protection and has the highest net benefits and benefit-cost ratio. This alternative would provide flood protection for all existing development in the flood plain of the watershed. Future development in the flood plain areas which are not protected by structural features of this plan will be subject to the no action--maintain the base condition alternative consisting of flood plain regulation, flood forecasting-flood warning and flood insurance. The selected plan (Alternate 6-C) would include flood proofing of nine additional homes in the reach from Bassett Creek Drive to Highway 100 in lieu of clearing and snagging, approximately 1.9 miles of bike paths and walkways and beautification measures at certain locations.

The selected plan differs from the environmental quality framework alternative in the reach from the Mississippi River to Irving Avenue and at Medicine Lake. Because flood proofing is socially unacceptable to residents around the lake and to preserve the fish spawning characteristics of Medicine Lake, the outlet structure would be relocated

approximately 500 feet downstream. At this location, the structure would not affect normal spring high water levels, but would provide additional discharge capacity at higher than normal spring water levels. This alternative for reducing flood damages around Medicine Lake would cost approximately \$15,000 more than the environmental quality framework alternative and approximately \$20,000 more than the national economic development plan, however, it is the only plan which is both environmentally and socially acceptable.

COMPARISON OF IDENTIFIED PLANS

A comparison of alternative plans consists of a series of trade-offs and iterations to analyze contributions of each plan to the planning objectives, national accounts, Federal interests and other important evaluation criteria as appropriate. The following figure provides a synopsis of features of the national economic development plan, the environmental quality plan, and the selected plan and tabulates important impacts of each plan. The figure illustrates the trade-off process used in the plan selection.

LEVEL OF PROTECTION

An optimum economic relationship exists when flood protection is provided against a flood having a recurrence interval on the order of once in 80 years. Recognizing the added benefits occurring from advance replacement, redevelopment and recreation (discussed in other sections of this report) an increase in the level of protection to about once in 500 years is economically feasible. However, protection against floods of a greater magnitude than the 100-year flood would not be acceptable to the Bassett Creek Flood Control Commission or the communities involved because of the changes that would be required in the water management envelope developed by the Commission over the past several years, the increased local costs resulting principally from the additional land and development cost outside the current adopted

envelope and the adverse impacts on the creek environment and aesthetics. Furthermore, an analysis of the selected project features and residual damages indicates that a high degree of protection is not warranted. That is, the project does not induce damages and does not include features (flood barriers) such that if their design capacity were exceeded, catastrophic damages would result. As flood level approach standard project flood levels, the proposed control structures are overtopped and the flood profile approaches that which would be expected under existing conditions.

Similarly, a plan providing protection from a flood having a recurrence interval of less than once in 100 years would not be warranted since such a plan would not be in accord with Federal and State flood-plain management criteria which relate to development in the 100-year flood-plain. The degree of protection can be increased from the economic optimum level of once in 80 years to 100-year protection with only a slight decrease in net benefits. Thus, in consideration of all of the above factors, protection against a flood having a recurrence interval of once in 100 years was chosen as the appropriate level of protection.

SUMMARY COMPARISON OF IDENTIFIED PLANS

Item	NED Plan	EQ Plan	Selected Plan
A. Plan Description	A. Flood storage and flood proofing - partial evacuation with new conduit in Third Avenue distributor right-of-way and deep tunnel (Alternate 6-C).	A. Flood storage and flood proofing - partial evacuation with an open space-open channel corridor to the Mississippi River (Alternate 6-E).	A. Same as NED plan.
	B. No action--maintain base condition consisting of flood plain regulation, flood insurance and flood forecasting-flood warning (Alternate 1) for Sweeney Lake Branch, North Branch upstream of Louisiana Avenue North and Plymouth Creek upstream of Medicine Lake.	B. Same as NED plan	B. Same as NED plan.
B. Significant Impacts	A. Plan removes about 160 acres from 100-year flood plain.	C. Retain the old Penn Avenue box culvert for aesthetics.	C. Approximately 10,000 feet of bike path and walkway from inlet of proposed conduit along creek corridor to Glenwood Avenue and from creek corridor via a bridge across railroad tracks to Bryn Mawr Meadows Park.
	B. Creation of 23 acres of urban open space.	D. Flood proof homes around Medicine Lake to maintain existing fish spawning characteristics of the lake.	D. Use of extensive beautification measures in the area of all structural flood control features.
C. Minor decrease in streambank erosion due to velocity reduction in channel and overbank areas and due to use of riprap in critical areas.	C. Minor decrease in streambank erosion due to velocity reduction in channel and overbank areas and due to use of riprap in critical areas.	E. Approximately 17,000 feet of bike path and walkway along creek corridor from Mississippi River to Theodore Wirth Park.	E. Eliminate clearing and snagging in reach from Golden Valley Road to T.H. 100.
	D. Drop structure in new conduit would prevent migration of undesirable rough fish species as well as same fish species from Mississippi River	F. Use of extensive beautification measures in the area of all structural flood control features.	F. Modify Medicine Lake outlet structure.
D. Drop structure in new conduit would prevent migration of undesirable rough fish species as well as same fish species from Mississippi River	A. Plan removes about 150 acres from 100-year flood plain.	G. Eliminate clearing and snagging in reach from Golden Valley Road to T.H. 100.	G. Same as NED plan impacts.
	B. Creation of 60 acre urban open space corridor which would enhance redevelopment of surrounding commercial-industrial area.	H. Undetermined number of trees and shrubs would be planted along open space corridor.*	H. Extensive project beautification measures would minimize degradation of aesthetic qualities of stream environment.*
E. Minor decrease in streambank erosion due to velocity reduction in channel and overbank areas and due to use of riprap in critical areas.	C. Minor decrease in streambank erosion due to velocity reduction in channel and overbank areas and due to use of riprap in critical areas.	I. Minor decrease in streambank erosion due to velocity reduction in channel and overbank areas and due to use of riprap in critical areas.*	I. Approximately 10,000 feet of bike path and walkway enhances recreational use of existing creek corridor and provide links connecting to two park areas.
	D. Drop structure in new conduit would prevent migration of undesirable rough fish species as well as same fish species from Mississippi River	J. Modified Medicine Lake outlet would maintain existing fish	J. Modified Medicine Lake outlet would maintain existing fish

B. Significant Impacts	A. Plan removes about 160 acres from 100-year flood plain.	A. Plan removes about 150 acres from 100-year flood plain.	A. Same as NED plan impacts.
B.	Creation of 23 acres of urban open space.	Creation of 60 acre urban open space corridor which would enhance redevelopment of surrounding commercial-industrial area.	Extensive project beautification measures would minimize degradation of aesthetic qualities of stream environment.*
C.	Minor decrease in streambank erosion due to velocity reduction in channel and overbank areas and due to use of riprap in critical areas.	Undetermined number of trees and shrubs would be planted along open space corridor.*	Approximately 10,000 feet of bike path and walkway enhances recreational use of existing creek corridor and provide links connecting to two park areas.
D.	Drop structure in new conduit would prevent migration of undesirable rough fish species as well as game fish species from Mississippi River to Bassett Creek watershed.*	Minor decrease in streambank erosion due to velocity reduction in channel and overbank areas and due to use of riprap in critical areas.	Modified Medicine Lake outlet would maintain existing fish spawning characteristics of the lake.*
E.	Increased flood storage on existing open space such as golf courses, natural areas and parks restricts use for up to 2 days longer following a flood period.	Degradation of aesthetic qualities of stream environment minimized by extensive project beautification measures.*	
F.	Undetermined but small number of trees removed for construction.*	Increased flood storage on existing open space such as golf courses, natural areas and parks restricts use up to 2 days longer following flood periods.	
G.	Aesthetic qualities of stream environment degraded due to structural flood control features.*	Undetermined but small number of trees removed for construction.*	
H.	Disruption of marsh downstream of Medicine Lake during construction of channel modifications.*	Approximately 17,000 feet of bike path and walkway enhances recreational use of existing and created creek corridor.	
I.	About 220 homes and 18 businesses protected from damage to 100-year flood.	About 220 homes and 18 businesses protected from damage due to 100-year flood.	
J.	Possible adverse effects on existing fish spawning characteristics of Medicine Lake.		
C. Contributions to Planning Objectives	1. Preserve quality of stream environment	A. Minimum disruption of existing aesthetic quality due to flood control structures.	Same as NED plan.
	B. Minimum disruption of natural stream environment due to flood control structures.	B. Minimum disruption of existing aesthetic quality due to flood control structures.	
	C. Creation of 23 acres of urban open space along creek.	C. Creation of 60 acres of urban open space.	
	D. Minor decrease in erosion potential.	D. Minor decrease in erosion potential.	
		E. More than 1 mile of free flowing stream would replace existing conduit.	

	D. Minor decrease in erosion potential.	D. Minor decrease in erosion potential.
	E. More than 1 mile of free flowing stream would replace existing conduit.	E. More than 1 mile of free flowing stream would replace existing conduit.
2. Flood damage reduction or compensation for losses	A. Average annual damages reduced by 88 percent.	A. Average annual damages reduced by 88 percent.
	B. About 272 homes and 18 businesses protected from damage due to 100-year flood.	B. Same as NED plan.
3. Social Acceptability	Plan generally socially acceptable.	Plan generally less socially acceptable due to higher local first cost.
D. Relationship to National Accounts		
1. National economic development	A. Average annual benefits associated with plan amount to \$674,100 (2).	A. Average annual benefits associated with plan amount to \$674,100 (2).
	B. Average annual cost associated with plan amount to \$579,300.	B. Average annual costs associated with plan amount to \$633,000.
	C. Benefit cost ratio: 1.14 (2).	C. Benefit-cost ratio: 1.06 (2).
2. Environmental quality	See significant impacts above.	See significant impacts above.
3. Social well-being	A. About 220 homes and 18 businesses protected from 100-year flood.	A. Same as NED plan.
	B. Reduced threat to life, health, and safety of residents.	B. Evacuation and relocation of numerous business and multiple family buildings required for right-of-way of open space-open channel corridor.*
	C. Evacuation of 3 homes and relocation of residents.*	C. Increase recreational opportunities.
E. Implementation Responsibilities		
1. Federal	Federal first cost of \$6,732,000 would be 71 percent of total first cost.	Federal first cost of \$7,329,000 would be 72 percent of total first cost.
2. Local	Local first cost of \$2,716,000 would be 29 percent of total first cost. Land, rights-of-way and easements account for largest portion, thereof. Operation and maintenance costs estimated at \$10,000 annually would be local responsibility.	Local first cost of \$2,811,000 would be 28 percent of total first cost. Land, rights-of way, and easements account for largest portion, thereof. Operation and maintenance costs estimated at \$10,000 annually would be local responsibility.

Footnotes: (1) Significant impacts specified in Section 122 of Public Law 91-611 and ER 1105-2-105 are shown with an asterisk (*).

(2) Not including advanced replacement benefits of \$162,000, recreation benefits of \$28,000 and redevelopment benefits of \$85,000.

(3) Not including land enhancement or intensification benefits which would result from future redevelopment along open-space-open

THE SELECTED PLAN

The preceding section of this report discussed the plan formulation and selection processes and identified the plan with the best potential for resolving the water and related land resource needs of the Bassett Creek watershed. The following pages present a broad description of the plan, including its accomplishments and significant design, construction, operation and maintenance aspects. Coordination with known interest groups and concerned citizens was maintained to insure that the selected plan was acceptable.

PLAN DESCRIPTION

The project would be designed to provide protection against a flood having a 1% chance of occurring in any one year (100-year frequency). Plate 2 provides information on the locations, limits and types of flood control improvements proposed. Also included in the plan are recreational bikeways and hiking trails along some portions of the creek in Minneapolis. These recreational bikeways and hiking trails, as well as specific beautification measures, will also be discussed in this section.

NONSTRUCTURAL FEATURES

As shown on Plate 2, not all reaches of Bassett Creek are subject to structural protection by the selected plan. In those portions of the Bassett Creek watershed which would not be protected by the structural flood control features of the plan, nonstructural flood control measures are proposed.

GOLDEN VALLEY ROAD (COUNTY ROAD 66) TO DRESDEN LANE

The selected plan proposes flood proofing as a supplement to the base condition for this reach of Bassett Creek. A total of three residences would be flood proofed along this reach. Flood proofing of these

three homes, as a supplement to the base condition, will prevent future flood damages resulting from a 100-year frequency flood.

NOBLE AVENUE TO UPSTREAM OF HIGHWAY 100

The selected plan proposes flood proofing as a supplement to the base condition in this reach of Bassett Creek. A total of sixteen homes would require flood proofing along this reach. Fifteen homes are located downstream of T.H. 100 and one home is located upstream of T.H. 100. The flood proofing of these sixteen residences as a supplement to the base condition will prevent future flood damages resulting from a 100-year frequency flood.

PLYMOUTH CREEK UPSTREAM OF MEDICINE LAKE

The selected plan proposes no action--maintain the base condition in this portion of the Bassett Creek watershed. There is no existing development within the 100-year flood plain along this reach, and flood plain regulation will prevent future flood damages.

NORTH BRANCH UPSTREAM OF LOUISIANA AVENUE NORTH

The selected plan proposes no action--maintain the base condition along this reach of the North Branch. There is no existing development within the 100-year flood plain along this reach of the North Branch, and flood plain regulation will prevent future damages.

SWEENEY LAKE BRANCH

The selected plan proposes no action--maintain the base condition along the Sweeney Lake Branch. There is no existing development within the 100-year flood plain along the Sweeney Lake Branch, and flood plain regulation will prevent future flood damages.

STRUCTURAL FEATURES

The principal features of the selected plan involve the use of flood storage in the upper watershed and a new conduit in the outlet reach of Bassett Creek as shown on Plate 2. To facilitate the discussion of the specific flood control features of the selected plan, the structural flood control features will be discussed for the various reaches of Bassett Creek.

MISSISSIPPI RIVER TO IRVING AVENUE NORTH

The selected plan includes a new conduit in the reach from the Mississippi River to approximately the inlet of the existing conduit along 2nd Avenue North. The proposed conduit from the Mississippi River to the intersection of 3rd Avenue North and Washington Avenue North would be constructed in cooperation with the Minnesota Highway Department. The proposed new conduit would outfall into the Mississippi River downstream of the Upper St. Anthony Falls Lock and Dam. This reach of the proposed conduit would consist of an 11-foot diameter tunnel through the St. Peter Sandstone. The route of the proposed conduit would run diagonally from the outfall to the intersection of Portland Avenue and 2nd Street South, follow 2nd Street South and 2nd Street North to the intersection of 2nd Street North and 3rd Avenue North and then follow 3rd Avenue North to Washington Avenue North. This 4,800-foot portion of the proposed new conduit would be built solely by the Minnesota Highway Department (MHD) at a slightly increased size to carry highway storm water drainage, as well as the Bassett Creek flood flows. The cost of this portion of the conduit would be shared based on peak flow rates in accordance with Minnesota Highway Department policy regarding cooperative drainage facilities.

The portion of the new conduit between the intersection of Washington Avenue North and 3rd Avenue North and approximately 11th Street North and Glenwood Avenue would be constructed in cooperation with the Minnesota Highway Department. The route of this portion of the conduit lies within the right-of-way of the proposed Third Avenue

highway distributor. The proposed Third Avenue highway distributor would provide a route connecting downtown Minneapolis to the Interstate highway system. The first cost of this cooperative conduit will be shared with the Minnesota Highway Department (MHD) based on peak flow rates. From Washington Avenue and 3rd Avenue North, approximately 850 feet along the 3rd Avenue distributor, this 8-foot diameter tunnel would be constructed through the St. Peter Sandstone. From that point to approximately 11th Street North and Glenwood Avenue, 2,300 feet of the proposed conduit would be of open-cut construction following the excavation of the depressed highway gradeline. Along the open-cut portion of this route, an 8-1/2 foot diameter reinforced concrete pipe would be placed in the trench and backfilled.

From the intersection of approximately 11th Street North and Glenwood Avenue, the proposed conduit would follow Glenwood Avenue to the right-of-way of Interstate 94, would cross the right-of-way of Interstate 94 to 2nd Avenue North and would follow 2nd Avenue North to approximately the location of the existing conduit inlet near Dupont Avenue North. The entire cost of this portion of the proposed new conduit would be the burden of the proposed flood control project. This portion of the proposed conduit consists of 3,200 feet of 8-1/2 foot diameter tunnel or pipe. From approximately 11th Street North and Glenwood Avenue to a point just north and west of the right-of-way of the Burlington Northern railroad tracks, the proposed conduit would be of liner plate construction through approximately 800 feet of glacial drift. From the point north and west of the Burlington Northern railroad tracks to the inlet of the proposed conduit, the conduit would be of open-cut construction beneath Glenwood Avenue and 2nd Avenue North.

At the inlet to the proposed conduit, an inundation flood storage area would be excavated to provide approximately 90 acre-feet of flood storage. This flood storage area would require approximately 20 acres of land along the south side of Bassett Creek between the inlet of the conduit and Irving Avenue North. A wetland pond area of approximately 10 acres would result from the excavation of this area. It is envisioned

that this wetland pond would be developed as a Type 4 or Type 5 wetland under the Fish and Wildlife Services wetland classification. The normal water surface of this wetland pond would be at approximately Elevation 800 and have an average depth of about 1 foot. During periods of normal flow, Bassett Creek would flow through this wetland pond before entering the proposed conduit. The control structure for this flood storage area would be located at the inlet to the proposed conduit. This flood storage control structure would consist of a drop-inlet structure and would include a trashrack to prevent debris from entering the proposed conduit. The remaining portions of the existing conduit would be abandoned following construction of the proposed flood storage area and conduit.

IRVING AVENUE NORTH TO GLENWOOD AVENUE

In the reach of Bassett Creek from Irving Avenue North to a point upstream of Penn Avenue North, the selected plan proposes approximately 3,000 feet of clearing and snagging to remove excessive natural and man-made debris from the channel and channel banks to improve the hydraulic efficiency of the channel. Trees in imminent danger of falling into the channel due to erosion of the root systems by flowing water would be removed. At locations where excessive brush impedes the flow of water, the brush would be thinned or removed.

As part of the selected plan, it is proposed to repair and modify the upstream wing walls of the Cedar Lake Road bridge. The existing wing walls consist of sheet piling with tie backs and are in a state of general disrepair. New concrete caps would be placed on the existing sheet piling and the tie backs would be repaired. This repair and modification will improve the hydraulic efficiency of the entrance to the Cedar Lake Road bridge. In addition, repair will assure that these wing walls will not collapse during a flood event and restrict flow through the Cedar Lake Road bridge.

The selected plan proposes to remove the old Penn Avenue crossing. This old box culvert crossing is not presently in use for vehicular traffic

and a new bridge is being constructed. The removal of this old crossing and the subsequent landscaping in the immediate area will improve the hydraulic efficiency of this portion across the creek valley at this location of the channel and result in flood level reductions upstream.

In the reach of Bassett Creek immediately downstream of Glenwood Avenue, the selected plan proposes approximately 1,020 feet of flood wall along the left bank of the channel to protect the industries located in this area and approximately 1,020 feet of retaining wall along the right bank. As part of the construction of these walls, the channel would be enlarged slightly through this reach to pass the required flood flows. These walls would replace the existing walls in the reach, which are in a state of general disrepair and of insufficient height to prevent flood damage from occurring to the industries located in the area. The existing low head rock dam in this reach would be replaced by a concrete ogee weir at the existing crest level.

GLENWOOD AVENUE TO DRESDEN LANE

The selected plan proposes increased flood storage on the Theodore Wirth Golf Course. The flood storage control structure for this storage site would be located immediately upstream of T.H. 55 and would be located on highway right-of-way. This flood storage control structure would consist of a modification of the existing creek crossing. A pair of large diameter culverts to pass normal and 100-year flood flows and an overflow weir to pass the flood flows resulting from a storm of greater magnitude than the 100-year frequency storm would be installed at the entrance to the existing crossing. The proposed flood storage control structure would result in a 100-year flood level approximately 2 feet higher than the existing 100-year flood level in the Theodore Wirth Golf Course area.

Just upstream of T.H. 55 in Theodore Wirth Golf Course, a fork leaves the main channel to the east flowing under the railroad tracks and under T.H. 55 to the east of the main channel crossing. Where T.H. 55 crosses this east fork of Bassett Creek, a new culvert would be

installed under T.H. 55 as part of the selected plan. This new culvert will assure that local runoff will not cause flooding problems on the upstream side of T.H. 55 in this area.

The flood control structure along the main channel of Bassett Creek provides increased flood storage on Theodore Wirth Park which reduces the peak flood flows to downstream reaches. As a result of the decreased peak flood flows immediately downstream of T.H. 55, the proposed 100-year flood level on Wirth Lake would be approximately 1.5 feet lower than the existing 100-year flood level. The normal level of Wirth Lake and the normal flows in Bassett Creek would not be affected by the proposed project.

DRESDEN LANE TO UPSTREAM OF HIGHWAY 100

As a part of the selected plan, approximately 300 feet of Dresden Lane at the outlet of Rice Lake would be raised to maintain access to residences in the area during flood periods. This road raise would average less than 2 feet and would prevent inundation of Dresden Lane as a result of a 100-year flood event.

The selected plan proposes flood storage on Rice Lake at approximately its existing 100-year flood level. At its existing 100-year flood level, the volume in the Rice Lake storage area would have to be increased by approximately 15 acre-feet. It is proposed to obtain this additional flood storage volume by relandscaping the area on the north end of the lake which has formerly been used for the disposal of demolition debris consisting of chunks of concrete, earth, wooden materials and other materials commonly found in building demolition debris. Following the relandscaping of this area, the selected plan proposes to cover this debris with a layer of earth followed by the spreading of black dirt and using plantings and seeding to aesthetically enhance the area and improve its compatibility with the rest of the Rice Lake natural area.

The selected plan proposes new culvert crossings at both Noble Avenue and Regent Avenue. These new crossings would consist of larger

culverts being placed at these channel crossings. Riprap would be required approximately 25 feet upstream of the inlets and approximately 50 feet downstream of the outlets at both of these new channel crossings in order to minimize potential erosion effects due to the high velocity flows through these culverts. At Minnaqua Avenue, the selected plan proposes the permanent removal of the Minnaqua Avenue bridge. A cul-de-sac would be constructed on Minnaqua Avenue on the east side of Bassett Creek, and the local residents would use one of several existing alternate routes instead of Minnaqua Avenue to cross the creek.

As part of the selected plan, about 1,800 feet of Toledo Avenue and West Bend Road would be raised an average of less than 2 feet. These road raises would prevent inundation of these streets during and insure access to the homes in this area during flood periods.

Due to existing severe stream bank erosion immediately downstream of the existing culverts under T.H. 100, the selected plan proposes to riprap the channel banks approximately 200 feet downstream of this existing crossing to minimize future erosion problems.

Immediately upstream of T.H. 100, the selected plan proposes a flood storage channel structure consisting of an earth embankment with a large diameter culvert and overflow weir. The embankment for this proposed flood storage control structure has a total length of approximately 1,700 feet and extends about 1,200 feet northward from the centerline of the main stem at this location. The maximum height of this structure is 11 feet at the point where it crosses the channel. This flood storage control structure consists of a large diameter culvert to pass normal and 100-year flood flows and an overflow weir to pass flood flows resulting from storms of greater magnitude than the 100-year frequency storm. This flood storage control structure results in a proposed 100-year flood level approximately 3 feet above the existing 100-

year flood level along the main stem upstream of the control structure. Approximately 800 feet of the channel immediately upstream of T.H. 100 would be cleared to remove natural debris and trees which are in imminent danger of falling into the creek and obstructing flood flows.

UPSTREAM OF HIGHWAY 100 TO MEDICINE LAKE

The selected plan proposes a new arch culvert crossing at Westbrook Road. The existing crossing at Westbrook Road has an insufficient discharge capacity to convey flood flows. The existing grade of Westbrook Road at the crossing would not be affected as a result of the new enlarged arch culverts, however, a portion of Westbrook Road would have to be removed to install the new culverts and would be replaced upon completion of construction.

At the downstream end of the Golden Valley Country Club golf course along the main stem, the selected plan proposes a flood storage control structure consisting of an earth embankment with a culvert and overflow weir outlet. This earth embankment is approximately 300 feet long and has a maximum height of 5 feet. The culvert through the embankment would pass normal flows and the overflow weir would pass the 100-year flood flow as well as flows resulting from storms of greater magnitude than the 100-year frequency storm. Flood storage on Golden Valley Country Club golf course would be at a 100-year flood level approximately 0.5 feet below the existing 100-year flood level. Flood storage upstream of this storage site reduces the peak flood flows entering the Golden Valley Country Club golf course area, however, the flood storage proposed on the golf course would further reduce the flood flows to downstream areas and prevent flood damages along the reach downstream.

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BASSETT CREEK WATERSHED HENNEPIN COUNTY MINNESOTA
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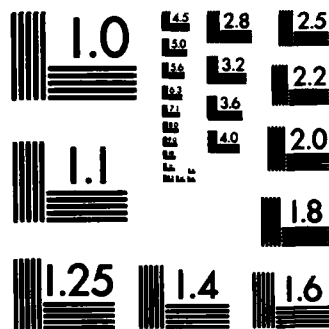
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NORTH BRANCH FROM 29th AVENUE NORTH TO LOUISIANA AVENUE NORTH

The proposed flood control structure upstream of T.H. 100 on the main stem of Bassett Creek will result in increased flood storage on Bassett Creek Park on the North Branch of Bassett Creek. The proposed 100-year flood level in Bassett Creek Park would be approximately 3 feet above the existing 100-year flood level. This increased flood level will result in the inundation of an additional 10 acres in the park as a result of the 100-year flood event. The proposed flood storage level in the park will not affect any of the existing active recreational facilities such as softball and baseball fields nor will it affect the picnic shelter and pavilion proposed by the City of Crystal.

Enlarged culvert crossings are proposed in the selected plan for 32nd Avenue North, Brunswick Avenue and Adair Avenue in order to prevent flood damage from occurring to residential properties upstream of these crossings. The selected plan also proposes to raise approximately 2,300 feet of 32nd, Brunswick and Adair Avenues to prevent inundation and loss of access. These road raises would consist of an average road raise of less than 2 feet. Some channel storage would be retained upstream of 32nd Avenue North at approximately the existing 100-year flood level as part of the selected plan.

A new culvert crossing is proposed at 34th Avenue North as part of the selected plan. This new crossing would consist of an enlarged culvert under 34th Avenue North and would provide flood storage in the reach from upstream of 34th Avenue North to the upstream side of Douglas Drive. The enlarged channel crossing would provide flood storage upstream to 34th Avenue North at approximately its existing 100-year flood level. Douglas Drive, where it crosses the North Branch of Bassett Creek, would be raised approximately 2 feet to prevent inundation as a result of a 100-year flood event.

The selected plan proposes a flood storage control structure between Douglas Drive and Florida Avenue North. This flood storage control structure would consist of an earth embankment with a culvert and an overflow weir. The earth embankment would be approximately 150 feet long and have a maximum height of approximately 18 feet. The culvert through the embankment would carry normal flows as well as the 100-year flood flow. The overflow weir would carry those flood flows resulting from storms of greater than the 100-year frequency storm. Upstream of this flood storage control structure, a flood storage area would be developed along the channel between the control structure and Louisiana Avenue North. The proposed 100-year level in this flood storage area would be approximately 4 feet below the existing 100-year flood level. In order to develop the required volume of storage at the required level to prevent flood damage, three residences between the control structure and Hampshire Avenue would have to be evacuated. Since one of these homes is currently owned by the City of Crystal as a result of a tax forfeiture, the evacuation would require the relocation of two families. New culvert crossings would be required as part of the selected plan at Florida Avenue and Hampshire Avenue. The Georgia Avenue crossing would be removed as part of the proposed plan and a cul-de-sac would be constructed south of the creek, and local residents would use one of several existing alternate routes to cross the creek. Between Hampshire Avenue North and Louisiana Avenue North, 1,100 feet of the creek channel would be enlarged to provide increased flood storage volume at the reduced flood level. This enlargement of the channel would be through the backyards of the residences located on both sides of the channel and would result in the removal of several large willow trees along this reach.

AESTHETIC AND ENVIRONMENTAL CONSIDERATIONS

Since the early phases of this study, many citizens of the Bassett Creek watershed have expressed concern regarding the effects of proposed flood control plans on the aesthetic quality of the natural stream setting. In response to these concerns, beautification measures are proposed to minimize the adverse effects of structural measures on the aesthetic quality of the stream environment. These proposed beautification measures would consist of rustication of all visible concrete surfaces, landscaping of earth embankments to enhance their visual appearance and, at necessary locations, visual barriers consisting of wooden fences and/or shrubbery would be constructed to enhance the aesthetic qualities of the natural stream setting. During post-authorization studies, detailed archaeological surveys and sampling programs would be conducted in accordance with the recommendations of the preliminary archaeological reconnaissance.

RECREATIONAL CONSIDERATIONS

In conjunction with the recommended flood control plan, recreation improvement measures would enhance portions of the project area. These measures include approximately 10,000 feet of bikeway and walk path along the creek corridor from the inlet of the proposed conduit to Glenwood Avenue and from the proposed flood storage area at the inlet of the conduit to Bryn Mawr Meadows Park and would include a bridge over the Burlington Northern railroad tracks along the northern edge of Bryn Mawr Meadows Park.

It is proposed that access ramps be gently sloped and constructed of suitable material to permit use by elderly persons. Use of the bikeway or walk paths by motorized vehicles would be prohibited. The location and extent of the proposed bikeway and walk path system are shown on Plate 3.

IMPACTS OF SELECTED PLAN

This section presents the expected economic, environmental and social impacts of the selected plan for a flood control project in the Bassett Creek watershed over an assumed 100-year economic life. Economic impacts include total project costs, total annual costs, and tangible flood control benefits attributable to the proposed project. Environmental impacts include project effects on floral and faunal communities and on air and water quality. Social impacts include project-related effects on existing and projected communal patterns and on the general health and safety of affected study area residents.

ECONOMIC IMPACTS OF FLOOD CONTROL

The outstanding economic impact of the proposed project would be alleviation of \$674,100 in average annual flood damages to business, public property, and residential and other private property in the Bassett Creek watershed. This estimate is based upon the economic analysis described in detail in the following paragraphs.

PROJECT COSTS

The estimated first costs and annual charges for the selected plan of improvement are based on a 100-year project economic life and a 6-1/8 percent interest rate and are summarized in the table blow. All costs are based on October 1975, conditions and price levels and include appropriate allowances for contingencies, engineering and design, and supervision and administration.

Summary of Estimated Projected Costs

Item	Cost
First Cost ¹	
Lands, Rights-of-Way, Easements	\$ 1,619,000
Relocations	1,349,000
Channels	5,150,000
Flood Walls	401,000
Recreation Facilities	154,000
Flood Control Structures	449,000
Engineering, Administration	<u>1,018,000</u>
TOTAL FIRST COSTS	\$10,140,000
Annual Costs	
Interest and Amortization	\$ 623,000
Maintenance	<u>10,000</u>
TOTAL ANNUAL COSTS	\$ 633,000

¹October 1975 Price Levels

FLOOD DAMAGES AND PROJECT BENEFITS

Average annual flood damages and benefits were evaluated for 1975 conditions and were projected to 1980, when it is assumed the project would be completed, by estimating interim economic growth. Due to the significant increase in flood discharge and flood levels in the watershed between conditions of existing urbanization and ultimate urbanization, damages and benefits were calculated for both these conditions. Discounted future damages and benefits were added to 1980 conditions to obtain average annual equivalent damages and benefits for the 100-year economic life of the project. A conservative projection of economic growth was made for the first 50 years of the assumed 100-year economic life of the project.

No growth was assumed for the remaining 50 years. The present worth of the difference between average annual damages and benefits for existing urbanization and ultimate urbanization was calculated assuming ultimate urbanization in 1995. The present worth of the annual average damages and benefits with ultimate urbanization were added to 1980 existing urbanization annual average damages and benefits to obtain average annual damages and benefits for the economic life of the project.

Flood damage surveys of the Bassett Creek watershed were made between 1970 and 1975. Flood damage estimates were made for the 10-year, 50-year and 100-year floods with existing urbanization and with ultimate urbanization. These surveys indicate 18 businesses and 222 residences would be damaged by the 100-year flood.

Flood losses in the Bassett Creek watershed include physical damage caused by inundation, business losses due to decreased production, loss of profits and wages and increased cost of normal operation and living. Residential damages include inundation losses to all residences and upper tenant structures, including building contents and damage to grounds. Damages include physical losses to properties and facilities used for retail and wholesale trade, services, manufacturing and warehousing. Wage and profit losses and increased cost of normal operations resulting from evacuation and cleanup are also included. Damages include all costs associated with physical flood losses to public property such as municipal buildings, sewage, water and park systems. Other losses to the public include additional costs incurred during flood emergencies such as evacuation; flood fighting; disaster relief; and extra duty for police, fire and martial units. Transportation damages consist of the cost of additional mileage required because of inundated roadways and resulting detours required.

FLOOD CONTROL BENEFITS

Benefits from flood damage reduction were evaluated as the difference in flood damages with and without the project. Average annual benefits

were calculated by subtracting average annual damages with the project from average annual damages without the project for both existing and ultimate development conditions. The increase in flood damages in the absence of a project results in an increase in benefits from those calculated for 1980 conditions. The average annual flood control benefits over the assumed 100-year economic life of the project are \$674,100.

RECREATION BENEFITS

Recreation benefits would be realized from expected use of the proposed trail system. The proposed improvements would satisfy part of the projected demand for facilities for bicycling, nature and pleasure walks, bird watching, hiking and fishing. Based on an expected overall increased annual use rate of 37,500 recreation days and a conservative user day value of \$0.75, the average annual recreation benefits would be \$28,100.

ADVANCE REPLACEMENT BENEFITS

The estimated costs of a complete repair of the existing conduit would be \$5,788,700 based on October 1975 construction costs. Construction of the proposed conduit would obviate the need for repairing the existing conduit. Accordingly, average annual costs of repair are considered to be a benefit attributable to the project. These costs are estimated to be \$145,200 based on interest and amortization computed at 6-1/8% over an assumed economic life of 100 years and assuming repair work would have to be completed by 1995 in order for the existing conduit to remain functional.

The estimated replacement cost for the existing floodwalls downstream of Glenwood Avenue would be \$369,900 based on October 1975 construction costs. Construction of the proposed floodwalls would obviate the need for replacement of the existing floodwalls. Accordingly, average annual costs of replacement are considered to be a benefit attributable to the project. These costs are estimated to be \$16,900 based on interest and amortization computed at 6-1/8% over an assumed economic life of 100 years and assuming the replacement work would have to be completed by 1985.

Total advance replacement benefits attributable to the project are estimated to be \$162,100

REDEVELOPMENT BENEFITS

The recommended plan will have an effect upon the local economy. The initial investment will create new jobs and income flows, thereby directly reducing unemployment and underemployment. There will be demands for both labor and construction materials required for project construction and incomes of individuals in associated industries will be increased indirectly due to the interrelationship and interdependence of these industries. Included are such industries as manufacturing, retail and wholesale trade, etc. These conditions will stimulate the economy which will raise the general level of income. In areas having persistent unemployment or underemployment, project benefits can be increased by the value of labor and other resources required for project construction. Parts of the area within commuting distance of the project have been designated as areas of persistent unemployment, and the benefits attributable to the relief of unemployment or underemployment in those areas would be \$85,400 based on interest and amortization computed at 6-1/8 percent over an assumed economic life of 100 years.

SUMMARY OF MONETARY BENEFITS

Benefits attributable to the selected flood control plan include tangible flood control benefits from the reduction of flood damages, tangible benefits from expected use of the proposed recreation features, advance replacement benefits and benefits associated with the decreased threat to human life and public health. Additional tangible benefits which result from the project, which were not evaluated, include the foregone cost of flood proofing, land enhancement and the savings in the administrative costs of flood insurance. Based on October 1975 prices, a 100-year economic life and a 6-1/8 percent interest rate, total average annual flood damage reduction benefits attributable to the project are \$674,100 and estimated average annual residual flood damages with the project are \$93,800. Average annual recreational benefits attributable to the proposed recreational features are \$28,100, advance

replacement benefits are \$162,000 and redevelopment benefits are \$85,400. A summary of average annual benefits is given in the following table.

Summary of Average Annual Benefits

Item	Average Annual Benefit
Flood Control	\$674,100
Recreation	28,100
Advance Replacement	162,100
Redevelopment	<u>85,400</u>
TOTAL	\$949,700

ECONOMIC JUSTIFICATION

The selected plan would result in total average annual benefits of \$949,700 and average annual costs of \$633,000. Therefore, the selected plan is well justified economically with a benefit to cost ratio of 1.50 as shown in the table below and an internal rate of return of 8.8 percent.

Summary of Average Annual Benefits and Costs

Total Average Annual Benefits	\$949,700
Total Average Annual Costs	\$633,000
Benefit-Cost Ratio	1.50
Existing Conditions, Average Annual Benefits	\$689,800
Existing Conditions, Benefit-Cost Ratio	1.09

IMPACTS ON THE NATURAL ENVIRONMENT

When the proposed flood control project is authorized, the implementation of the project can be anticipated to cause impacts on the natural environment. This section of this report discusses these impacts as they are now anticipated.

The route followed by the proposed conduit is through an area of existing commercial and industrial development. Portions of the proposed conduit would be constructed as a tunnel underground and portions would be constructed of precast pipe under highway right-of-way or under the right-of-way of existing city streets and, therefore, would not result in any adverse or beneficial impacts on the natural environment.

Upon completion of the proposed new conduit and diversion of the Bassett Creek flow from the existing conduit to the proposed conduit, the proposed conduit will create a barrier which will prevent the migration of fish and perhaps certain aquatic invertebrates through the conduit. The fish barrier will be intentionally created by using a steeply sloping section of the conduit or a drop structure in the conduit to prevent the migration of fish through the conduit. According to the Minnesota Department of Natural Resources, preventing the migration of rough fish from the Mississippi River into the Bassett Creek watershed would be a beneficial impact on the natural environment because of the growing magnitude of the rough fish problem throughout the metropolitan area. Although some more desirable fish species will also be prevented from migrating through the conduit into the creek, the long-term benefits which could result from rough fish reduction and the subsequent reduction in the habitat competition for the more desired species is anticipated to enhance the watershed's sport fisheries. However, before existing populations of rough fish would be reduced, other measures would have to be undertaken in the watershed.

During periods of normal flow, a wetland pond of approximately 10 acres would occupy a portion of the flood storage area at the inlet to the proposed conduit. It is anticipated that this wetland pond would be developed as a Type 4 or Type 5 wetland under the Fish and Wildlife Services' wetland classification. The construction of this flood storage area would result in a severe adverse effect, if not complete destruction of the existing aquatic environment in the 1,500 feet of the creek between the inlet of the existing conduit and Irving Avenue North. The existing fish habitat in this reach supports a variety of small minnows and rough fish. Following the construction at the site, the aquatic environment would, over time, reestablish itself, although the ecological system may be one of a Type 4 or Type 5 wetland pond rather than a confined stream channel. Construction of the flood water storage area at the conduit inlet would disrupt approximately 20 acres of undeveloped land. Following construction, landscaping, plantings, sodding and seeding would provide enhanced wildlife habitat in the 10 acres of upland area as well as soil erosion stabilization. The proposed inundation area and wetland pond will provide habitat for limited numbers of waterfowl, marsh birds, song birds, and various species of small mammals, reptiles and amphibians. The wildlife habitat in the area would be enhanced by the removal and covering of demolition debris in the area with the excavated earth.

The construction of a flood wall and a retaining wall in the reach immediately downstream of Glenwood Avenue and the associated channel widening would have long-term adverse impacts on the vegetation and wildlife in the area. Several elm and cottonwood trees of various sizes would be removed from the bank of the creek during the construction of the retaining wall. The channel widening would eliminate some wildlife habitat in the area of construction. Approximately 1/2 acre of wildlife habitat would be permanently destroyed as a result of the channel widening and wall construction. The aquatic habitat of fish and aquatic invertebrates would be temporarily disrupted during the construction, however, no long-term effects would be anticipated.

The increased area of inundation of Theodore Wirth Golf Course would result in temporary disruptions of wildlife habitat during flood periods. Since it is expected that the water level through the golf course will return to about 1 foot above normal within 9 days with proposed conditions as compared to about 7 days with existing conditions following a 100-year flood event, no long-term effects on the wildlife habitat or the existing plant succession are anticipated.

To provide additional drainage for local storm water, a new culvert crossing would be provided at T.H. 55 along the eastern branch of the creek. This branch of the creek currently has undesirable water quality due to water stagnation problems in the reach and providing this new culvert would tend to improve the existing water quality by providing more flow through the area during periods of normal flow and during flood periods.

The increased flood storage on Theodore Wirth Golf Course will result in reduced flood levels along the creek downstream of T.H. 55. As a result of the reduced flood levels downstream of T.H. 55, the existing 100-year flood level on Wirth Lake will be decreased approximately 1.5 feet. The normal water level of Wirth Lake as well as the ponds in Theodore Wirth Golf Course will remain unchanged as a result of the proposed flood control structure and new culvert crossing at T.H. 55.

The flood control structure upstream of T.H. 100 on the main stem of Bassett Creek increases the 100-year flood level in Bassett Creek Park on the North Branch approximately 3 feet resulting in an additional 10 acres of inundation area within the 100-year flood plain. Since it is expected that the water level in the park would return to about 1 foot above normal within a few days following a 100-year flood event, no long-term effects on the wildlife habitat or existing plant succession are anticipated.

The relocation of the Medicine Lake outlet will permit additional discharge capacity at flood stages without affecting the normal spring highwater levels which will preserve the existing fish spawning characteristics of the lake. Approximately 1/5 acre of wetland would be required for construction of the embankment and the water depth would be increased on 1/2 acre of Type 2 wetland changing it to Type 3 or Type 4 wetland.

Between Douglas Drive and Florida Avenue North, a restrictive flood storage control structure will be constructed on the North Branch of Bassett Creek. The construction of this flood control structure would require disruption of approximately 1/6 of an acre of land for the construction of an earth embankment, culverts and overflow weir. The short-term adverse effects on the natural environment would be minimized by landscaping, restoration and beautification measures following the completion of the construction of the embankment. No adverse long-term effects on the natural environment are anticipated as a result of the construction of this flood storage control structure.

Between the flood control structure and Hampshire Avenue North, approximately 26,000 cubic yards of earth would be excavated, three residences would be evacuated, enlarged culverts would be placed at the Florida and Hampshire Avenue channel crossings, and the Georgia Avenue channel crossing would be removed to provide flood water storage in this area. The excavation of this area would result in a short-term adverse impact on the existing wildlife habitat and the existing water quality along this reach of the creek; however, no long-term adverse effects to the natural environment would be anticipated due to landscaping, restoration and beautification measures which would be carried out following the construction phase. The evacuation of the three residences and the removal of the Georgia Avenue crossing would result in a net beneficial gain in the natural open space available in this area and would provide a net long-term gain in the potential habitat for birds and small mammals. During the excavation of the flood storage area, an undetermined, but relatively small, number of large elm trees would be removed. These

trees would be replaced by plantings following the construction of the flood storage sites.

Between Hampshire Avenue and Louisiana Avenue, a flood storage area would be excavated along the existing channel through the backyards of residences along this reach. Approximately 3,400 cubic yards of earth would be removed and an undetermined, but relatively small number of large willow trees would have to be removed as a result of this excavation. The long-term impacts of this action would be minimized through landscaping, restoration and beautification measures following the completion of construction.

SOCIAL AND CULTURAL IMPACTS

Social and cultural impacts can be anticipated as a result of the proposed action. These social and cultural impacts are discussed in the following paragraphs.

RECREATION

The acquisition of approximately 20 acres for flood storage in the area immediately upstream of the conduit entrance provides the opportunity to develop recreational open space along the creek. The area would be developed as an inundation storage area and with a permanent wetland pond to provide a natural area for passive recreational activities during non-flood periods. Development of this natural area along the biking and hiking trails would enhance the recreational potential of the area. The residents of the area have expressed a desire to enhance the recreational potential of the Bassett Creek corridor in Minneapolis.

Increased flood storage on Brookview, Golden Valley and Theodore Wirth golf courses will increase the adverse effect of flooding on the use of these courses during flood periods. It is anticipated that as a result of the proposed action, that Theodore Wirth and Brookview Community

golf courses will be closed for use up to two additional days following a 100-year flood event. The proposed 100-year flood level on Theodore Wirth Golf Course is approximately 2 feet above the existing 100-year flood level and results in the addition of approximately 15 acres to the 100-year flood plain. The proposed flood level on Golden Valley Golf Course is approximately 0.5 feet below the existing 100-year flood level and results in a decrease of approximately 5 acres in the 100-year flood plain. The proposed 100-year flood level on Brookview Community Golf Course is approximately 1 foot above the existing 100-year flood level and results in the addition of approximately 35 acres to the 100-year flood plain. No significant adverse effects on the golf course turf due to sedimentation, waterlogging or accumulation of debris are anticipated to result from the proposed action. Post flood cleanup expense will increase slightly due to the greater area affected by flood water and has been considered part of the residual flood damages.

Increased flood storage on Bassett Creek Park in Crystal will result in a 100-year flood level approximately 3 feet above the existing 100-year flood level. This results in approximately 10 acres of inundation area being added to the 100-year flood plain. The proposed flood level will not inundate the proposed picnic shelter and pavilion nor will it affect the existing baseball and softball fields and other active recreational facilities in the park. There would be no excavation in the park although the embankment for the flood control structure on the main stem would be constructed along a portion of the east side of the park. Landscaping, plantings and other beautification measures will minimize the adverse effects on the aesthetic quality of the park due to the construction of the embankment.

The proposed action will result in reduced flood levels on two lakes within the watershed. The proposed 100-year flood level on Wirth Lake would be approximately 1.5 feet below the existing 100-year flood level. The reduced flood level on Wirth Lake will result in a reduction of the adverse effects of flooding on the swimming beach. The proposed 100-year flood level on Medicine Lake would be approximately 0.5 feet below the existing 100-year flood level. The reduced flood level on Medicine Lake

will provide a minor reduction in the adverse effects of flooding on swimming beaches and proposed boat launching facilities on the lake.

The proposed flood storage area between Douglas Drive and Hampshire Avenue along the North Branch of Bassett Creek will add approximately 2 acres of open space along the creek. Landscaping and restoration following the excavation of the storage site will enhance the aesthetics of approximately 5 acres of existing open space along the creek.

HUMAN ASPECTS

The evacuation of three residences and the relocation of the residents would cause significant disruption of their life-styles. They would experience the considerable personal inconvenience of moving and adjusting to a new neighborhood. This would be considered objectionable by those people affected and this adverse social impact should be considered carefully. One of the three homes is currently owned by the City of Crystal as a result of a tax forfeiture and thus would not require the relocation of people due to the evacuation of this structure. Evacuation of two of the homes allows the development of a flood storage area which would result in 4 foot reduction in the 100-year flood level in the Markwood Drive area which would remove twenty-six homes from the 100-year flood plain. One of the evacuated homes is subject to substantial flood damages as a result of existing flood levels. Thus, the long-term social benefits resulting from the evacuation of these three homes would seem far greater than the short-term adverse social effects.

Flood proofing of nineteen homes in the watershed would cause short-term disruption of the life-styles and personal inconvenience to the affected residents during the flood proofing modifications. However, the long-term reduction in the flood threat and related economic losses sustained by the property owners would at least partially offset the short-term adverse social effects of flood proofing. Most of these homes would be subject to only minor flooding of walk-out basements and the residents may wish to obtain flood insurance in lieu of the flood proofing modifications.

Beneficial social impacts of the proposed action would include flood protection for about 220 families and 18 businesses thereby reducing economic losses, community disruption and potential threats to public health and safety incurred during flood periods. Adverse social impacts would include evacuation of three homes and relocation of two families, flood proofing of about nineteen homes and temporary disruption of the aesthetic qualities in localized areas due to construction of structural flood control features.

AESTHETIC ASPECTS

All structural features of the proposed project would be subjected to additional beautification measures to minimize the adverse effects on the aesthetic quality of the stream environment. These proposed beautification measures would consist of rustication of all visible concrete surfaces, all earth embankments would be subjected to landscaping and planting measures to enhance their visual appearance and at necessary locations, visual barriers consisting of wooden fences and/or shrubbery will be constructed to enhance the aesthetic qualities of the natural stream setting. During post-authorization studies, beautification and aesthetic enhancement should be major considerations in final layout and design of project features.

DIVISION OF PLAN RESPONSIBILITIES

Division of responsibilities between the Federal Government and non-Federal interests is discussed herein. In accordance with formal resolutions adopted 12 September 1974 and 31 October 1975, the City of Minneapolis agreed to assume the non-Federal responsibilities for the proposed project. The following would be the responsibility of the local sponsor:

- Provide, without cost to the United States, all lands, easements, and rights-of-way including suitable areas for borrowing and disposal of excavated material, as determined to be necessary by the Chief of Engineers for construction, operation and maintenance of the project.
- Hold and save the United States free from damages that may result from construction and maintenance of the project, not including damages during construction, operation and maintenance which are due to the fault or negligence of the United States or its contractors.
- Maintain and operate the project, after completion in accordance with regulations prescribed by the Chief of Engineers.
- Share in the cost of the non-structural portion of the project in accordance with cost sharing provision being developed under Section 80 of Public Law 93-251.
- Accomplish without cost to the United States all relocations and alterations of buildings (except non-structural measures), transportation facilities, and storm and sanitary sewer systems, public and private utilities, local betterments, drainage facilities, and other structures and improvements made necessary by construction of the recommended plan, as determined by the Chief of Engineers, excluding facilities necessary for the normal interception and disposal of local interior drainage at the line of protection.
- In acquiring lands, easements and rights-of-way, for construction of the project, the local sponsor will comply with the applicable

provisions of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970", Public Law 91-646, approved 2 January 1971.

- Prescribe and enforce regulations to prevent obstruction or encroachment on channels and ponding areas which would reduce their flood-carrying capacity or hinder maintenance and operation.
- Provide a cash contribution for recreation equal to 50 percent of the final reparable cost allocated to this function less a credit for the value of lands, easements, rights-of-way, alterations and relocations allocated therefore.
- Publicize flood plain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project.
- At least annually inform affected interests regarding the limitations of the protection afforded by the project.

Nonstructural measures such as flood plain regulation which would complement the proposed plan would be a non-Federal responsibility, although technical advice would be furnished. Federal assistance relating to other means would still be provided apart from this project.

The major purpose of this section is to present pertinent information regarding cost apportionment between Federal and non-Federal interests for the proposed plan. The proposed improvements are generally for a single purpose; however, related recreational and aesthetic measures are included. Since the recreational facilities and resulting benefits do not have a decisive influence on project feasibility, the recreational purpose and costs were considered incidental, and cost allocation between project purposes was not considered appropriate.

COST APPORTIONMENT

Apportionment of cost for the proposed improvement between Federal and non-Federal interests is based on existing Federal legislative and administrative policies governing flood control. In this regard, all costs associated with construction of a new conduit including road replacements, installation of flood walls, modification of the existing channel, the construction of control structures to create temporary inundation areas and aesthetic treatments are assigned to the Federal government. In addition, the Federal government would pay a share of that portion of the proposed conduit between the outlet and the intersection of 3rd Avenue North and Washington Avenue which would be constructed for cooperative purposes by the Minnesota Department of Highways. The percent of Federal participation in the cooperative drainage conduit will be in proportion to the ratio of the contributing flows of Bassett Creek, to the sum of the contributing flows or peak discharges in the cooperative conduit. The Federal Government would also pay a share of that portion of the proposed conduit which would be constructed for cooperative purposes as part of the flood control project, from 3rd Avenue North and Washington Avenue to approximately 11th Street North and Glenwood Avenue, based on the ratio of the contributing flows of the highway project to the sum of the contributing flows or peak discharges in the cooperative conduit. Local interests would provide all lands, easements and right-of-ways; pay for all modifications to existing channel crossings; make necessary relocations and/or modifications of utilities; pay for all roadway raises except those required due to increased flood storage levels and operate and maintain the project after completion.

Local interests would also bear one-half of the first costs of all recreational facilities and the total cost for their operation and maintenance.

The distribution of costs including appropriate engineering design, supervision and administration costs is shown on the following table.

Apportionment of Costs Among Interests

Item	Federal	First Costs	
		Non-Federal	Total
Lands, Right-of-Way, Easement		\$1,619,000	\$ 1,619,000
Relocations	\$ 288,000	1,061,000	1,349,000
Channels	5,150,000		5,150,000
Flood Walls	401,000		401,000
Recreation Facilities	104,000 ¹	50,000 ¹	154,000
Flood Control Structures	449,000		449,000
Engineering, Administration	839,000	179,000	1,018,000
TOTAL	\$7,231,000	\$2,909,000	\$10,140,000

¹Cost apportionment based on a 50% Federal, 50% non-Federal cost sharing policy for Recreational Facilities less credit for lands.

All maintenance, operation and replacement costs for the proposed project are assigned to non-Federal interests. Estimated annual charges based on a 6-1/8 percent interest rate and a 100-year project economic life are given in the table below. No interest during the construction has been applied to the annual charges, as it is anticipated that the project would be completed in two consecutive construction seasons or slightly more than one year.

Annual Charges

Federal Annual Charges

Interest and Amortization (7,231,000 x .06141)	\$444,000
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Non-Federal Annual Charges

Interest and Amortization (2,909,000 x .06141)	\$179,000
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Maintenance	10,000
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Total Non-Federal Annual Charges	189,000
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Total Project Annual Charges	\$633,000
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PLAN IMPLEMENTATION

The steps necessary to bring the proposed plan of improvement for flood control in the Bassett Creek Watershed to reality are summarized as follows:

- The report would be reviewed by such higher authorities as the Corps of Engineers, North Central Division, the Board of Engineers for Rivers and Harbors, and the Office of the Chief of Engineers.
- The Chief of Engineers would seek formal review and comment by the Governor of Minnesota and interested Federal agencies.

Following the above review, the Secretary of the Army would seek comments of the Office of Management and Budget regarding the relationship of the project to the President's program. The final report of the Chief of Engineers would then be forwarded by the Secretary of the Army to Congress.

- Following appropriate review and hearings by the Public Works Committees of Congress, a project for flood control and related purposes in the Bassett Creek Watershed could be authorized.
- If the project were authorized, the Chief of Engineers would include funds in his budget requests to Congress for design and construction.
- If initial funds were appropriated, formal assurances of local cooperation would be requested from the official project sponsor.
- Plans, specifications, and cost estimates would be prepared by the St. Paul District Engineer; bids invited; and a contract awarded. Necessary local actions, including furnishing necessary lands and payment of cash contributions, would be required at this time.

- Upon completion of the project, local interests would commence project operation and maintenance.

It is not possible to accurately estimate a schedule for plan implementation. However, once the project is authorized and initially funded, it would take about 4 to 5 years to complete designs and construction, if subsequent funds were appropriated as needed. When proposed structural flood control measures are constructed, current flood plain regulations would have to be amended to reflect the conditions modified by the structural measures. In addition, coordination with the Flood Insurance Administration will be necessary to enable them to adjust their flood insurance premium rates and revise their flooded area maps. In the meantime, local governmental interests are encouraged to continue enforcement of flood plain regulations in the area, and local individuals are encouraged to participate in the flood insurance program.

COORDINATION WITH OTHER INTERESTS AND PUBLIC INVOLVEMENT

Throughout the study, coordination among Federal, State and local interests played an important role in the development of a comprehensive resources plan for the Bassett Creek watershed. Input concerning water resource management alternatives in the Bassett Creek watershed was received from Federal, State and local agencies during early phases of the study and their views were considered during the continuous planning process. The Bassett Creek watershed contains portions of nine municipalities, Crystal, Golden Valley, Medicine Lake, Minneapolis, Minnetonka, New Hope, Plymouth, Robbinsdale and St. Louis Park. The problems and needs of the various communities differ significantly because of their diversity of character. Also because of the developed nature of the watershed and the number of communities involved, coordination was maintained with a substantial number of interested individuals, groups and organizations.

The first public hearing on the flood problems in the Bassett Creek watershed was conducted by the St. Paul District, Corps of Engineers on 30 January 1963. At that time, local interests indicated that they favored retaining flood runoff in temporary storage and ponding areas and in the natural lakes of the watershed to control flooding. Local interests indicated that they objected to any flood control plan which would adversely affect the natural beauty of Bassett Creek. Between 1963 and 1969, the Golden Valley Flood and Drainage Committee actively studied the water resource related problems of the Bassett Creek watershed. On 18 May 1972, a public hearing was held by the Bassett Creek Flood Control Commission on the possible adoption of a Watershed Management Plan for Bassett Creek. Generally, local interests supported the policies of the Commission, as outlined in the Management Plan, to control future development in the flood plain and in potential flood storage areas, until a flood control plan for the watershed could be selected. At that hearing, local interests emphasized the need to involve the public in the plan selection process.

In 1973, during the preliminary feasibility study, public meetings were held in municipalities throughout the Bassett Creek watershed. At these meetings, past, current and possible future flood problems of the watershed were discussed. The objectives of interested citizens and organizations and their views of current and future problems and needs were solicited. The importance of social, environmental and community factors in the identification and evaluation of alternative flood control measures were apparent. During the preliminary studies, several communities organized informal citizen advisory groups to assist in the evaluation of the problems and needs of the public. These interested citizens assisted in keeping the public informed of the status of the study and provided a vehicle through which public input on the alternative solutions could be obtained.

Upon completion of the preliminary feasibility study, a report presenting the results of the study was distributed for comment to interested Federal, State and local interests. This interchange of information with various agencies and local interests assisted in establishing workable combinations of alternatives and in narrowing the range of feasible alternatives.

Upon initiation of the studies for this feasible report, it became obvious that because of the diversity of the communities in the watershed, the differing problems and needs of the communities and the large number of interested citizens that individual workshop meetings should be held in each of the affected communities. The first workshop meeting was held in Minneapolis on 26 February 1975. Past, current and possible future activities in the Bassett Creek watershed and the need for community input and the identification of the water and land resource problems and possible solutions as perceived by the community were emphasized. As a result of this meeting, the Minneapolis Task Force on Bassett Creek was formed. The major emphasis on the Task Force was to evaluate all alternative solutions to the flooding problem which could also focus attention on the creek corridor through Minneapolis and increase its value as an asset to the residents and businessmen in the neighborhoods adjacent to Bassett Creek and to the city as a whole. The Task Force prepared

and distributed an outline of their proposed planning efforts and a questionnaire to determine the importance of various activities along the creek corridor to residents of the area. An implementation plan to focus attention to the creek corridor was also prepared by the Task Force.

Workshop meetings were also held in each of the other communities of the Bassett Creek watershed except Medicine Lake. These meetings were held with city planning commissions, environmental commissions, organized citizen advisory groups and groups of interested citizens and other local interests. All meetings included the informal evaluation and discussion of alternatives and the identification of the principal concerns of varying interests. Generally, the public involvement program has:

1. Established a need to protect the health and safety of the residents of the watershed.
2. Emphasized the need to minimize the effects of the plan on the existing aesthetic and environmental qualities of the creek or to enhance the existing environmental and aesthetic qualities.
3. Indicated a desire to develop the recreational potential of the creek corridor.
4. Indicated a desire for feasible combinations of structural and nonstructural measures to minimize adverse impacts of the alternatives on the residents of the watershed.

In addition to the public workshops, several articles discussing the possible alternatives were published in local suburban newspapers and a synopsis of the various alternatives was prepared and distributed to local interests.

A draft Bassett Creek watershed feasibility report was completed in August 1975 and distributed to all interested Federal, State and local agencies and to interested citizens for their review and comment. The

draft report identified a selected plan of improvement for the Bassett Creek watershed. A summary sheet of the significant comments received with related discussions is shown on the following figure.

Agency Comments on the Bassett Creek, Draft Feasibility Report for Flood Control

Agency	Comments	Response
U.S. Department of the Interior National Park Service	1. Our Midwest Archeological Center concurs with the Minnesota Historical Society's statement that an archeological survey of the project area is needed.	1. An archeological survey of the project area has been conducted and the report has been revised to reflect the results of the archeological survey. In addition, the Minnesota Highway Department is currently conducting an archeological survey as part of their environmental impact statement for the highway project.
U.S. Department of the Interior Fish and Wildlife Service	<p>1. The relocation of several homes is a positive approach toward solving long-term floodplain problems. Perhaps several of the homes to be flood-proofed could also be relocated. With a benefit/cost ratio of 1.9 some additional costs resulting from home relocation may be acceptable.</p> <p>2. The use of parks and golf courses as temporary flood water storage area is an acceptable and appropriate function of the floodplain.</p> <p>3. The 20-acre, Type IV and/or Type V wetland "ponding" area created at the inlet to the proposed conduit would provide valuable habitat for "urban" waterfowl, particularly the expanding Canada goose population.</p> <p>4. We support the views expressed by citizens of the watershed at the several public meetings regarding the unacceptability of channel modifications and realignments and that the creek should be left in its existing state wherever possible.</p> <p>5. The Metropolitan Council of the Twin Cities area and the City of Minneapolis have expressed interest in an open space proposal calling for the development of a Bassett Creek Parkway similar to the open-space channel corridor of outlet alternate E. Consideration of this proposal may depend on the results of the Open Conduit Feasibility Study being conducted by the City of Minneapolis. The total development of a parkway and open conduit would protect and enhance the natural environment of the creek. We urge that a final decision on the recommended plan not be made until after this study has been completed and reviewed.</p> <p>6. The feasibility report indicates that the water quality of Wirth Lake has deteriorated significantly and that the process is accelerating. Water quality testing on the stream should continue in an effort to locate and abate water pollution sources. Alternatives such as "no action" or channelization would further degrade the lake's water quality and would be unacceptable.</p> <p>7. The report indicates that, in general, the recreational facilities available to the general public in Hennepin County are adequate to meet existing needs. The future recreational needs of the area should be investigated further and discussed in the report.</p> <p>8. The report does not clearly indicate the diversity of fish and wildlife species present in the study area.</p> <p>9. A 0.5 foot reduction in the 100-year flood level of Medicine Lake would reduce the flood damage potential around the lake. Unfortunately, the lowering of the lake during the spring flood period would also result in the loss of natural northern pike spawning areas along the edge of the lake. We recommend that a controlled northern pike spawning in combination with a carp barrier be constructed on the lower one mile of Plymouth Creek to compensate for the loss of northern pike spawning areas around the lake due to the proposed lowering of the 100-year flood level. The development should be closely coordinated with the Minnesota Department of Natural Resources.</p> <p>10. The proposed underground conduit outlet to the Mississippi River should be designed as a fish barrier to prevent movement of fish upstream from the river. A barrier in the conduit will allow existing carp populations to be controlled by the application of selective carp toxicant.</p>	<p>1. While floodplain evacuation is a positive approach to solving the long-term flood problems more extensive evacuation in the Bassett Creek watershed would result in severe adverse social impacts and is socially unacceptable to the people being protected. Only in those areas where individual homes or businesses must be removed to construct flood control works or where they cannot be economically protected by other measures is floodplain evacuation a viable solution to the flood problems in the Bassett Creek watershed.</p> <p>2. Comment acknowledged.</p> <p>3. Comment acknowledged.</p> <p>4. Comment acknowledged.</p> <p>5. The Open Conduit Feasibility Study being conducted by the City of Minneapolis may or may not find the open space proposal feasible. However, city officials view the open space proposal as a long-range planning proposal since it would take several years to acquire the necessary right-of-way and to complete the plans. Delay in recommending a plan for the reduction of flood damages would allow the social and economic burden of flooding on residents of the watershed to continue, particularly in the commercial and industrial area near the inlet to the existing conduit. Should the existing conduit fail during a major flood event, catastrophic flooding would occur in the vicinity of the conduit inlet. Construction of a new conduit in cooperation with the Minnesota Highway Department provides a dual purpose facility at a significant cost saving to the taxpayers when compared to separate facilities. Delay in recommending a plan for the Bassett Creek watershed would result in the loss of the opportunity to construct this dual purpose facility which would provide immediate flood damage reduction and significantly reduce the threat of catastrophic flooding in the vicinity of the conduit inlet. Construction of the new conduit in cooperation with the Minnesota Highway Department would not preclude the future development of an open space-open channel corridor should the Open Conduit Feasibility Study find the proposal to be feasible and the proposed new conduit could continue to function as a flood control structure to reduce the threat of flooding in the City of Minneapolis.</p> <p>6. The water quality monitoring program initiated by the Bassett Creek Flood Control Commission in 1972 has identified general water quality problem areas throughout the watershed. The water quality monitoring program currently being undertaken by the Bassett Creek Flood Control Commission is intended to locate the sources of contamination and, with the cooperation of the Minnesota Pollution Control Agency, improve the existing water quality throughout the watershed including Wirth Lake.</p> <p>7. During the course of this study, parks and recreation directors from each of the municipalities except Medicine Lake were interviewed. The purpose of these interviews were to identify the recreational resources of the watershed as well as any existing or future unmet recreational needs were identified. In response to these unmet recreational needs in the City of Minneapolis, the recommended plan includes approximately 10,000 feet of bikeway and walk path along the creek corridor including a link to nearby Bryn Mawr Meadows Park. During advanced design studies, coordination will be maintained with local, regional, state and federal agencies to assure that any future needs which can be satisfied as part of the project will be identified.</p> <p>8. Report revised to reflect comment.</p> <p>9. Further coordination with representatives of the Fish and Wildlife Service and the Minnesota Department of Natural Resources resulted in a revision of the proposed outlet of Medicine Lake so that flood levels resulting from runoff events of a magnitude less than a 20-year frequency would not be lowered.</p> <p>10. It is intended that the proposed new conduit be designed to provide an effective fish barrier. It became obvious during the early stages of the study that a fish barrier to prevent the upstream migration of carp and other undesirable rough fish from the river would enhance the watershed's fisheries.</p>
U.S. Department of Commerce National Oceanic and Atmospheric Administration	1. Flood forecasting-flood warning services are available through the National Oceanic and Atmospheric Administration (NOAA) National Weather Service Forecast Office in Minneapolis, Minnesota. An appropriate discussion of these services should be in the report.	1. Flood forecasting-flood warning services are discussed under No Action--Maintain Base Condition (Alternate 1) and this discussion has been revised to reflect the full range of services available to the Bassett Creek watershed through NOAA's National Weather Service Forecast Office in Minneapolis, Minnesota.

U.S. Department of the Interior
Geological Survey

1. The report does not evaluate the impacts of the various phases of the proposed project on water table conditions in the glacial drift nor on artesian heads in the sandstone and dolomite aquifers. Effects on the tunneling and channelization on groundwater hydraulics, storage, water levels and possibly local underflow in artesian aquifers should be considered.

1. Report revised to reflect comment.

U.S. Department of the Interior
Bureau of Outdoor Recreation

1. The report should make reference to the Twin Cities Level B Study. Any proposed developments should be coordinated with the final level B report to assure compatibility with the recommendation of the study.
2. The selected plan involves flood storage on Jordan Park (Bassett Creek Park) and Brookview Community Park. Portions of these parks have been acquired with monies from the Lake and Water Conservation Fund (LWCF) administered by the Bureau of Outdoor Recreation (Project 27-00000, Jordan Park and Project 27-00267, Brookview Recreation Area). The report should indicate LWCF involvement in these parks.
3. The report states that an earthen embankment will be constructed along the eastern boundary of Jordan Park (Bassett Creek Park). The dimensions of this embankment (height, number of acres of park land required) should be indicated.
4. The use of Bassett Creek Park and Brookview Community Park for flood storage may constitute a change in land use. Any changes in land use within a park funded with Lake and Water Conservation Funds creates a section 6(f) conflict. The possibility of a section 6(f) conflict should be discussed and resolved.

1. Report revised to reflect comment.
2. Comment: A feasibility study was conducted to determine the extent of the park as shown on the map. The park land would be required for the embankment. The study also showed the lake and water conservation fund involvement in the park.
3. Further coordination with the Minnesota State Planning Agency and the National Flood Insurance Administration has revealed that the use of Bassett Creek Park and Brookview Community Park for flood storage does not constitute a section 6(f) conflict.

U.S. Environmental Protection
Agency

1. Although the proposed project is primarily concerned with flood control in the watershed, the Feasibility Report is somewhat lacking in the attention it gives to water quality. The report does not inventory industrial and municipal point discharges or non-point sources of pollution within the Bassett Creek watershed, with continued urban development expected in the watershed, consideration should also be given to the environmental impact of increased urban runoff upon water quality.
2. It is not clear from the report whether or not structural measures will adversely affect the natural purifying capacities of the streams on which they are proposed. These structural measures include those that will significantly alter channel widths, depths, velocities and discharges.
3. The effect of the selected plan on groundwater quality is not included in the report. In view of the fact that groundwater quality in the watershed is generally deteriorating, the effects of implementing these aspects of the selected plan which should tend to increase groundwater absorption would be reported. Additionally, the report should discuss the ramifications, if any, of the proposed project upon the water table in areas of the watershed adjacent to construction sites.
4. We agree with local citizens and the Feasibility Report that extensive channel modifications within the watershed are undesirable and unnecessary. However, some channel widening and excavation are nevertheless proposed in the selected plan, and, at this stage in planning, the report should address measures which will be taken to minimize and control pollution from construction activities. Since a considerable amount of earth materials will be displaced during excavation and channel widening, it will be imperative to know whether or not bottom and stream bank sediments are polluted. Excavation of polluted materials could have a serious degrading impact upon water quality and upon potential disposal sites.
5. We presume that the 8, 8-1/2, and 10 foot diameter conduits proposed for the section between Irving Avenue North and the Mississippi River will be capable of accommodating the discharge of a 100-year flood. However, the maximum discharge this conduit system can accommodate should be stated within the report.
6. We appreciate recreational improvements and beautification measures proposed in conjunction with flood protection, and also the attention the report directs toward floodplain regulation. Good floodplain management should definitely be required in conjunction with the proposed project. The model ordinance of the Bassett Creek Flood Control Commission is straightforward and sound in its approach to floodplain regulation. But provision for enforcement of floodplain regulations is less clear, and the attitudes of individual communities and other private interests within the watershed should be discussed. Potential conflicts and uniformities should be addressed in the planning stage. A contradiction appears to exist between proposed floodplain regulations and anticipated future land use in the 100-year floodplain (Appendix 1, B-60). Specifically, Table 25 indicates that residential, commercial and industrial land use is expected to increase sharply within the 100-year floodplain. Such development would have to be viewed as having a degrading impact upon the environment. In summary, the implementation of floodplain regulations needs to be clarified.

1. An inventory of point and nonpoint sources of pollution within the Bassett Creek watershed and an evaluation of the effects of increased future urban runoff on water quality are included in the report.
2. The effect of the proposed project on groundwater quality is not included in the report. In view of the fact that groundwater quality in the watershed is generally deteriorating, the effects of implementing these aspects of the selected plan which should tend to increase groundwater absorption would be reported. Additionally, the report should discuss the ramifications, if any, of the proposed project upon the water table in areas of the watershed adjacent to construction sites.
3. The natural purifying capacity of the creek from the Mississippi River to the inlet of the conduit will be improved by abate of increased velocities and the proposed drop structure in the conduit. Normal and low flows in the remainder of the watershed would not be significantly altered and, therefore, its existing natural purifying capability will not be affected. On the main stem of Bassett Creek, flood discharges are reduced between the conduit entrance in Minneapolis and Brookview Community Park in Golden Valley. On the North Branch of Bassett Creek, channel discharges during flood periods are increased between Bassett Creek Park and 16th Avenue North. However, these floodwaters are then temporarily stored in Bassett Creek Park.
1. Report revised to reflect comment.
2. In areas where the creek is intermittent, construction activity and restoration can be completed during periods when there is no flow in the creek. In other areas, construction could be accomplished during periods of low flow and the creek diverted by pumping or other measures. During advanced planning stages, soil samples will be taken in the areas to be excavated to evaluate the potential effect of excavation on water quality and to determine if special disposal techniques are required for the excavated materials.
3. Report revised to reflect comment.
4. As discussed in Appendix 1-1, Minnesota statutes require communities to adopt and enforce floodplain management regulations six months after notification that sufficient information is available to do so. As also discussed in the report, all of the communities in the Bassett Creek watershed have adopted regulations or are in the process of adopting them. The ordinances adopted by the communities have been reviewed and approved by the Minnesota Department of Natural Resources in accordance with State statutes. It is not the intention of floodplain regulations to prohibit development, but rather guide development in the floodplain areas. Development of floodplain areas for residential, commercial and industrial purposes is possible if these developments are flood-proofed or elevated to non-damagable levels and provided they do not significantly increase flood damage potential in other areas.

State of Minnesota
Department of Highways

1. It should be noted that although maintenance of the portions of the conduit constructed in highway right-of-way will be conducted by the Minnesota Highway Department, costs for such maintenance will be apportioned between appropriate interests and the Minnesota Highway Department in the same manner as the original construction costs.

1. Report revised to reflect comment.

Agency	Comments	Response
State of Minnesota Department of Natural Resources	<p>1. The selected plan proposed to reduce the 100-year flood level on Medicine Lake by repairing the existing outlet pier and by modifying the channel downstream of this repaired outlet structure. There are two fisheries' problems which must be addressed with this proposed action.</p> <p>First, reduction in spring high-water levels of a fraction of a foot will reduce the amount of shoreline marsh areas available for northern pike spawning. To offset this loss, a minimum of 20 acres of controlled northern pike spawning area, acceptable to DNR, will have to be established in Plymouth Creek or another suitable location in Medicine Lake's immediate watershed.</p> <p>2. The removal of natural obstructions (stumps, brush, logs, rock, vegetation and its by-products) in and along the stream will significantly alter or destroy fish and wildlife habitat. The use of interpretation of the adjective "excessive" used to describe this debris is questioned. What criteria will be used to determine the amount of this "natural debris" to be removed from Bassett Creek? Removal of trees with partially exposed root systems and snags will eliminate habitat for fishes and other aquatic organisms. The need for removal of "stands of extremely dense brush" is also questioned. The species and numbers of fish and wildlife inhabiting the stream sections to be snagged and cleared should also be determined.</p> <p>3. An additional responsibility of the local sponsor is to acquire all the necessary permits from the State of Minnesota.</p> <p>4. The total value of tangible flood losses will increase in the future, as stated, but not for all of the reasons given. It should be noted that future urban renewal programs and continued residential, industrial and commercial development in the floodplain are subject to floodplain regulations which requires flood protection to the 100-year flood level. Furthermore, future improvements and structural replacements are also permitted under floodplain regulations which require them to be protected against flooding. Therefore, new development in the floodplain and structural alterations and replacements of existing structures would have a minimal contribution to future flood losses.</p> <p>5. The following sentence is ambiguous: "Channels would be designed for easy maintenance, stable side slopes and adequate freeboard." What specifically is adequate freeboard?</p> <p>6. It is stated that the proposed floodwall on the left bank of the channel downstream of Glenwood Avenue would not be built to the Standard Project Flood elevation because a flow split would occur upstream of the floodwall. We request additional information pertaining to this.</p> <p>With the proposed project at what elevation would this flow split occur? Would the flow split occur at an elevation below the Standard Project Flood and above the elevation of the proposed floodwall? Our primary concern is: would the floodwall be overtopped before the channel split occurs upstream?</p>	<p>1. Further coordination with representatives of the Fish and Wildlife Service and the Department of Natural Resources has resulted in a revision of the proposed outlet for Medicine Lake, so that normal high spring water levels will not be affected. Flood levels resulting from runoff events of a magnitude less than a 20-year frequency would not be lowered.</p> <p>2. The proposed plan has been revised to eliminate clearing and snagging in Golden Valley. Clearing and snagging will be conducted from the conduit entrance to Cedar Lake Road where failing retaining walls and considerable man-made debris impair the hydraulic efficiency of the channel.</p> <p>3. Comment acknowledged.</p> <p>4. Report revised to reflect comment.</p> <p>5. An allowance for freeboard above the computed water surface elevation in a channel is generally provided so that during a design storm the channel will not overflow due to possible variations in hydrology, embankment settlement, super-elevation of flow at curves, formation of waves, or other unexpected hydraulic performance. The amount of freeboard allowed will vary depending on the type of construction, size of channel, consequences of overflow, velocity of flow and possible effect of debris accumulation at crossings. Each situation must, therefore, be evaluated separately to determine the freeboard requirement.</p> <p>6. A flow split will occur at a flood level of approximately elevation 822 upstream of Glenwood Avenue approximately 4 feet below the elevation of the Standard Project Flood. As illustrated on the flood profile, plate H-15, there is a substantial head loss at the Glenwood Avenue crossing with large flood flows and a significant change in the flood profile downstream of Glenwood Avenue. Because of the head loss at Glenwood Avenue, the flow split would occur before the floodwall is overtopped.</p>
Minnesota Pollution Control Agency	<p>1. The MPCA recognizes the primary purpose of the project is to control flooding on Bassett Creek. In addition, storm water drainage from the proposed I-94 freeway will be an integral part of the preferred alternative. There is concern that the project in its entirety is not considered in one EIS. We recognize the logical break in the Highway EIS and Corps EIS takes place where flood control meets the highway drainage point. Both responsibility of construction and economics change at this point. We do, however, feel that the total impact of the flood control project should be assessed in addition to the highway drainage to include effects on the Mississippi River, groundwater, etc. from the combined project.</p> <p>2. It would be important to discuss the water quality to include the location and extent of storm sewage and an inventory of point source discharges including the characteristics of the discharges. Second, the effects on water quality from clearing, snagging and sediment removal cannot be assessed until information is made available on whether the bottom and stream bank sediments are polluted. Third, the effects on increased future urban runoff should be discussed. Finally, there should be an assessment and a statement on what, if any, water quality standards will be violated by the action.</p> <p>3. The Agency is concerned over the general deterioration of certain groundwater supplies in the area. It is necessary to include in the EIS, a discussion on the effect on groundwater. The watershed, during most of the year, is a discharge area for groundwater, but during the dry periods, the area would temporarily be recharging. Some discussion is necessary on how and when this occurs in conjunction with the environmental effects that might result from the project.</p> <p>4. The effect on this project on hydraulics of the watershed is presently unclear. What effect will the project have on stream velocities and low flow? Will the project affect the assimilative capacity or the natural purification capabilities of the streams involved? Will the lakes have reduced or increased flushing rates? These questions are important to the overall assessment of impacts.</p>	<p>1. The Minnesota Highway Department is currently conducting an analysis of the environmental impacts of their highway drainage project.</p> <p>2. An inventory of point and nonpoint discharges and an analysis of the effects of runoff from future development is beyond the scope of this study, however, the Bassett Creek Flood Control Commission has initiated an intensive stream monitoring program to identify reaches in the stream where water quality is being affected by point and nonpoint discharges. When these reaches have been isolated, the Commission intends to investigate methods of eliminating or reducing the effects of point and nonpoint sources on water quality in those reaches. The Bassett Creek Flood Control Commission is also conducting studies of the effect of increased urban runoff on the water quality of the creek, lakes and ponds in the watershed and is evaluating alternate methods of minimizing the effects of increased urban runoff on water quality. During advanced planning studies, bottom and stream bank sediments will be sampled to determine if they are polluted. Water quality standards would not be violated by the proposed action.</p> <p>3. During construction, groundwater levels would be reduced in the immediate vicinity of construction areas because of dewatering, however, they would return to normal soon after construction. During flood periods, groundwater levels would be slightly higher than normal in the vicinity of flood storage areas for several additional days. The existing recharge to aquifers during dry periods would not be affected by the project.</p> <p>4. Flood flow velocities downstream of the proposed control structures will be reduced, however, low flow discharges will not be affected. The existing assimilative capacity and existing natural purification capabilities of the stream will not be reduced and the flushing rates of the lakes in the watershed will not be affected.</p>

$$\begin{aligned} \frac{\partial}{\partial t} &= \cos \theta \frac{\partial}{\partial \theta} + \sin \theta \frac{\partial}{\partial \phi} \\ \frac{\partial}{\partial \theta} &= \cos \theta \frac{\partial}{\partial \theta} + \sin \theta \frac{\partial}{\partial \phi} \end{aligned}$$
[illegible]

It is not clear, however, how the use of the new information to reduce emissions will be paid for. In the report, it is expected that current regulatory regulations will be amended to reflect the present test conditions and the new emissions reductions would then apply to all other plants with aeration systems.

The existing flood stage flood plain elevation of the existing structure is approximately elevation 889. A review of Plate #4-11, the existing flood stage flood plain elevation of Winnetka Avenue is 896. The existing structure is located in fairly close proximity to the report, to reduce flood damage to the area of interest from the Winnetka Avenue structure, the 190-year flood stage of Winnetka Avenue is reduced to 896. The existing structure is located in fairly close proximity to the report, to reduce the flood stage of Winnetka Avenue from 896 to 889, thereby reducing the flood storage volume must be provided upstream of Winnetka Avenue. Assuming that private property between Brookview Community Park and County Road 14 were completely filled and developed providing no flood storage or private property then the 190-year flood level would be approximately elevation 889 or 1 foot above the existing flood level of approximately elevation 888. As mentioned in the report on page 14-13, "The existing structure at Winnetka Avenue would have a flood stage flood plain elevation of 889, and a flood stage flood plain elevation 895 and a flood stage flood plain elevation 879. With a standard project flood, the structure at Winnetka Avenue would be inundated and the water surface profile would approach normal or existing conditions. The estimated elevation of the standard project flood in this area is around 911b or 22 ft."

1. If the proposed project were implemented, it is expected that the existing flood zone elevation contained in Golden Valley's Flood Plain Regulations would be amended to approximately elevation 889, depending upon the outcome of later, more detailed studies. The amended ordinance would continue to allow the development of the flood plain areas below elevation 889 to the extent that its anticipated use would not unduly affect the efficiency of the flood plain. Because of the necessary flood storage below 889, a reflector can be obtained on existing public properties and because private properties could be developed consistent with the ordinance, it is not expected that any reduction would be made applicable to existing conditions.

2) consistent with the effects of other National existing Flood Plain Regulations, any placement into the flood plain (below elevation 890) are allowable if they do not unduly affect the capacity of the flood plain, needs of those "flood fringe" areas requires that all damageable property be elevated or flood protected to the regular or flood protection elevation. It is expected that elevating structures on fill or flood protecting structures which would be located below a flood protection elevation would be more economically feasible than flood barriers as a means of flood protection. Non-damageable property (e.g., dunes, recreation areas, and parking areas) would be subject to the same flood plain and restricted flood zone regulations.

Since Bassett Creek is not as yet subject to the provisions of Section 404 of the Federal Water Pollution Control Act Amendments of 1972, it would be premature to assess the possible impacts of this legislation of the proposed flood control plan. The proper time for the assessment, if necessary, would be during the post-authorization study phase when the Section 404 will have been in effect and more data are available.

5. If an open channel were constructed to replace the existing conduit, it would not affect the amount of storage required in upstream communities to prevent damage in those reaches unless all of the existing restrictive channel crossings were enlarged and the channel modified to permit unrestricted flow of the 100-year flood discharge. At the present time, there are 26 restrictive channel crossings on the main stem of Bassett Creek between the existing conduit entrance and the Brookview Community Park. In order to permit unrestricted flow of the 100-year flood discharge, all of these crossings would have to be replaced with bridges and the channel between the conduit entrance and Brookview Community Park would have to be enlarged substantially. Because channel modifications and realignments are socially unacceptable to residents of the watershed, as discussed in the report (page C-11), and because the extensive modification of the channel and crossings would be economically infeasible, a plan to provide unrestricted flow for the 100-year flood was eliminated as a possible alternative early in the planning process.

Wallace L. Freeman

1. The present 100-year flood level in the area where Mr. Freeman owns property is between 887 and 888 feet and it is on the 888 foot elevation that Mr. Freeman, for several years, has based his plans for developing his property. On May 15, 1972, the City of Plymouth zoned this property for commercial and multiple residential property and approved Mr. Freeman's development plans which were based on a 100-year flood level of 888 feet. The selected plan, as set out in the Draft Report, as we understand it, would increase the 100-year flood level over Mr. Freeman's property by at least one foot to 889 feet. If storage for flood waters to a level of 889 feet is necessary over Mr. Freeman's property, we estimate that approximately 20 acres of commercial and multiple residential property would be effectively removed from development....
2. If our understanding, as obtained through such study and the October 9th meeting is correct, then the impact on Mr. Freeman's property is minimal with one exception. That is, that even if no portion of Mr. Freeman's property is required for flood water storage purposes, it will be necessary for Mr. Freeman, at the very least, to fill portions of his land to an elevation of 890 feet in order to develop it in accordance with his development plans formerly submitted to the City of Plymouth. Such cost of flood proofing is not included in the Draft Statement. We respectfully submit that this cost should be recognized in the Final Environmental Impact Statement and Mr. Freeman should be compensated accordingly.

1. Development of the property in question is, at the present time, subject to the policies of the Bassett Creek Flood Control Commission. In accordance with the "Watershed Management Plan for Bassett Creek", adopted by the Commission in 1972, land use of a type which would be damaged by flood waters is not permitted below elevation 890 in this area. Allowable types of land use below elevation 890 would include parking areas, storage areas, recreation areas, and open space if they do not increase flooding. The Management Plan allows filling of areas below elevation 890 for development if compensating flood storage or increased channel capacity can be provided.

It is proposed to reduce the 100-year flood discharge at Winnetka from 830 cubic feet per second to 400 cubic feet per second as listed in Table 4, page H-17 of the report. To reduce the discharge to 100 cubic feet per second, 500 acre-feet of flood storage must be provided upstream of Winnetka Avenue. It was assumed that private properties upstream of Winnetka Avenue would be filled and developed consistent with existing land use plans and, therefore, the resulting proposed flood level was determined to be elevation 889.

2. Existing policies of the Bassett Creek Flood Control Commission would require damageable property to be located above elevation 890 in this area. Therefore, portions of the property would have to be filled to approximately elevation 891 with existing conditions. With proposed conditions, damageable property would have to be located above elevation 889 which would require portions of the property to be filled to approximately elevation 890. The cost of flood proofing the property would, therefore, be less with proposed conditions than the cost of flood proofing with existing conditions.

A notice of the late stage public meeting was prepared and distributed to interested Federal, State and local interests in September, 1975. The notice contained a brief discussion of the problem, alternative solutions considered and a description of the tentatively selected plan. Approximately 4,500 copies of the notice were distributed and in addition, local news media publicized the meeting. The late stage public meeting was held jointly by the St. Paul District, Corps of Engineers and the Bassett Creek Flood Control Commission in Robbinsdale, Minnesota, on 15 October 1975 and was attended by approximately 350 people. The proposed plan of improvement was presented and questions concerning the plan were discussed. Several local officials and interested individuals expressed support for the plan. Several individuals were opposed to certain features of the plan and requested that final designs be coordinated closely among the various interests. A resolution expressing the willingness of the City of Minneapolis to provide the required local cooperation was adopted on 12 November 1975. In addition, the Cities of Golden Valley, Crystal, Plymouth, Robbinsdale, St. Louis Park and Minnetonka adopted resolutions supporting the plan.

SUMMARY

This investigation has verified the potential for severe flood problems in the Bassett Creek watershed. Flood control improvements, including nonstructural and structural alternatives and combinations thereof, were evaluated to determine if flood damage reduction is feasible and desirable. This investigation has also identified programs available through other governmental agencies as potential solutions to these problems.

Flood plain regulation, by itself, would reduce damages to future development, but would do little for existing flood plain developments. Flood plain regulation is, however, considered a necessary supplement to any structural plan. Flood insurance would provide compensation for flood damages incurred, but would not reduce flood damages or related social problems. In addition, flood insurance would provide limited economic protection for future developments, if used as a supplement to flood plain regulation. Permanent flood plain evacuation would be socially disruptive, economically infeasible and unacceptable to local interests. Flood proofing and partial evacuation throughout the Bassett Creek flood plain would be socially disruptive, economically infeasible and unacceptable to local interests. However, along short reaches of Bassett Creek, flood proofing and partial evacuation provides a viable flood damage reduction alternative since other alternatives do not provide the required flood damage reduction or are technically, economically or environmentally infeasible. In the upper Bassett Creek watershed, channel modification and diversion alternatives would be economically, socially and environmentally infeasible or undesirable. In the reach of Bassett Creek from the Mississippi River to Irving Avenue, five outlet alternatives were evaluated in detail. These included three new conduit alternatives, the repair of the existing conduit and one open channel alternative. While the open channel alternative is the most environmentally beneficial, economically only plans involving the construction of a new conduit or repair of the existing conduit are justified.

Of the many alternatives evaluated and coordinated with Federal, State and local interests, the proposed plan was selected as best meeting the flood and related water and land resource needs in the Bassett Creek watershed consonant with the objectives of national economic efficiency and environmental quality.

The proposed flood control plan in the lower watershed would generally include a new conduit in the right-of-way of the proposed Third Avenue highway distributor to a proposed deep tunnel outletting into the Mississippi River below the St. Anthony Falls Lock and Dam. The conduit and tunnel would be constructed cooperatively with the Minnesota Department of Highways. Cooperative construction of these drainage facilities would result in an estimated cost savings of \$5.5 million as compared to construction of separate drainage facilities for the highway project and for the Bassett Creek watershed.

In the upper watershed, the proposed flood control works would generally include a series of small control structures to temporarily impound flood waters on existing golf courses, parks and open space areas throughout the watershed; a new control structure to reduce flood levels on Medicine Lake; new channel crossings; limited reaches of channel modifications and clearing and snagging; necessary relocations and alterations of utilities; and a permanent marsh impoundment near the conduit entrance to provide temporary flood storage and for the enhancement of wildlife. Also included in the plan are features to enhance recreational opportunities including pathways for hiking and bicycling, access ramps and overlooks.

In addition to the proposed structural measures, local interests would be encouraged to continue existing flood plain management programs consisting of flood plain regulations, flood insurance and flood forecasting, flood warning and emergency protection measures in unprotected and undeveloped areas of the watershed.

The proposed project would provide protection to developments in the Bassett Creek watershed against a flood having a 1 percent chance of

occurring in any 1 year (100-year frequency). The proposed aesthetic treatment plan serves as a guide for further investigation and presents only concepts which would be used. Specific designs would be prepared during the post-authorization study phase and would be coordinated with local interests in insure compatibility with the natural and human environment.

The estimated total first cost of the proposed project would be \$10,140,000. Annual charges and annual benefits would be \$633,000 and \$949,700, respectively. The overall benefit-cost ration is 1.50.

Construction of the overall project facilities would involve a joint effort between the Corps of Engineers and the Minnesota Department of Highways. The Corps would be responsible for constructing all project works directly related to the Bassett Creek flood control project including all facilities in the upper watershed and that portion of the conduit linking Bassett Creek to the drainage facilities proposed by the Minnesota Department of Highways. The Minnesota Department of Highways would be responsible for constructing the cooperative drainage facilities including the conduit along the Third Avenue highway distributor and the deep tunnel outletting Bassett Creek flows and highway drainage to the Mississippi River.

The current schedule of the Minnesota Department of Highways calls for awarding a contract to construct a portion of the cooperative drainage facilities in 1976 and for completing construction in about 2 years.

The conduit and deep tunnel proposed by the highway department must be oversized to carry the Bassett Creek design flow. The costs for oversizing the conduit and deep tunnel allocated to the Bassett Creek flood control project are currently estimated at \$1,951,000. These costs are all assigned to the Federal Government in accordance with the normal cost sharing policies for flood control projects. However, based on the provisions of Section 215 of Public Law 90-483, 90th Congress (Flood Control Act of 1968), any costs incurred for oversizing the conduit

and deep tunnel prior to project authorization must be borne by non-Federal interests without reimbursement by the Federal Government. Non-Federal interests in this case would be the Minnesota Department of Highways or the local sponsor. The law further specifies that the amount of reimbursement is limited to \$1 million for any such project works constructed by non-Federal interests following project authorization.

Most of the cost savings of \$5.5 million that could be realized by constructing a cooperative drainage facility would be a savings to the Federal Government. Thus, in view of the cost savings involved, it is considered appropriate and in the best interests of the public in this case to provide for reimbursement of non-Federal interests for the full amount of any costs they might incur toward payment of the Federal share of the cooperative drainage facility.

Including the costs for the cooperative drainage facility, the Federal share of the overall flood control project first cost is \$7,231,000 and the non-Federal share is \$2,909,000. Following construction, non-Federal interests would commence the maintenance of project facilities. The local sponsor would be responsible for maintaining the non-cooperative drainage facility and all project facilities in the upper watershed of Bassett Creek. The Minnesota Department of Highways would be responsible for maintaining the cooperative drainage facilities with partial reimbursement for the costs of maintenance from the local sponsor.

A preliminary draft environmental statement was prepared concerning the proposed plan of improvement and comments were requested from all interested parties. Comments received are attached to the revised draft environmental impact statement.

STATEMENT OF FINDINGS

I have reviewed and evaluated, in light of the overall public interest, the documents concerning the proposed action as well as the stated views of other interested agencies and the concerned public, relative to the

various practicable alternatives considered in the formulation of a plan for flood control in the Bassett Creek watershed.

BACKGROUND

Authority for the study is contained in two resolutions; one adopted 7 April 1962 by the Senate Committee on Public Works and the other adopted 24 September 1970 by the House Committee on Public Works. The resolutions were adopted in response to requests made by local interests who desired development of a plan for flood control and related purposes in the Bassett Creek watershed.

The Bassett Creek watershed is located within the Minneapolis-St. Paul metropolitan area and entirely within Hennepin County. The watershed includes portions of Minneapolis and eight suburban municipalities including: Crystal, Golden Valley, Medicine Lake, Minnetonka, New Hope, Plymouth, Robbinsdale and St. Louis Park. Bassett Creek is tributary to the Mississippi River.

Flooding on Bassett Creek can occur from either summer storms or spring runoff. During the past 2 years, three major floods have occurred along the creek. Areas susceptible to flood damages include residential developments in the upper watershed and commercial and industrial developments in the lower watershed where Bassett Creek flows through a 1-1/2 mile conduit under Minneapolis before outletting into the Mississippi River. The existing conduit is in a state of critical disrepair and failure of any section along the conduit could cause catastrophic damages in Minneapolis.

The study was conducted cooperatively with the Bassett Creek Flood Control Commission, an organization comprised of representatives from each of the nine municipalities in the watershed and established in 1969 under the Joint Powers Act of the State of Minnesota. Prior to development of the proposed plan of improvement, the Commission, with the services of a private engineering firm completed a Water Management Plan outlining

a flood plain regulation program for the watershed and a preliminary feasibility report representing various flood damage reduction alternatives and recommending further studies with the objective of developing a plan for flood control in the watershed. Following preparation of the preliminary feasibility report and approval by the Corps of Engineers, the Commission requested active involvement of the Corps in preparing a final feasibility report recommending a plan for the watershed. Thus, preparation of the final feasibility report represents the culmination of this effort.

The overall study program was extensively coordinated with Federal, State and local interests. Several meetings were held by the Commission at the local level during preparation of the Water Management Plan and the preliminary feasibility report. In addition, Federal, State and local agencies were afforded the opportunity to review and comment on the preliminary feasibility report. These comments were recognized during preparation of the final feasibility report. Coordination of the final feasibility study involved a joint effort between the Corps of Engineers and the Bassett Creek Flood Control Commission. Fifteen meetings were held with the local citizenry in the various municipalities of the watershed to seek their views on the alternatives under consideration. Following distribution of the draft feasibility report, a late stage public meeting was held in October 1975 to obtain the further views of all concerned interests on the selected plan. The end result of the extensive coordination led to the adoption of a plan that is generally more acceptable to the public than previously developed plans.

THE SELECTED PLAN

The selected plan for the Bassett Creek watershed involves a combination of both nonstructural and structural measures. Nonstructural measures include flood proofing of 19 residences and evacuation of 3 residences in the upper watershed and continuance of local flood plain ordinances modified to reflect proposed conditions.

The plan includes two principal structural measures; one, a new conduit to replace the existing conduit outletting Bassett Creek to the Mississippi River and the other, a series of small control structures in the upper watershed to temporarily impound flood waters. The lower portion of the new conduit would be constructed in cooperation with the Minnesota Department of Highways under its proposed Interstate Highway program in Minneapolis. Cooperative construction of the new conduit would result in estimated cost savings of about \$5.5 million and would prevent severe damages that could occur to industrial developments under present conditions.

Other structural measures included in the selected plan in the upper watershed include a limited reach of channel widening, snagging and clearing, road raises, bridge removals, culvert replacements and construction of a new weir at the outlet of Medicine Lake.

The temporary flood water storage impoundments and other structural measures acting in conjunction would reduce flood damages to residential developments in the upper Bassett Creek watershed. The new weir structure at the outlet of Medicine Lake would reduce flood water levels of the more infrequent floods and thereby reduce damages to residential properties abutting the lake.

None of the features of the selected plan would alter normal stream-flow or lake level conditions.

Associated features of the selected plan include the development of a permanent marsh impoundment at the entrance to the proposed conduit, which reduces flood damage, provides wildlife enhancement, and contributes to the development of a recreation trail system for bicycling and walking. The trail system would provide a link between existing parks and trails at the lower end of the watershed.

ALTERNATIVES

In addition to the no action alternative, all of the other available means of reducing flood damages were investigated as alternatives to the proposed action.

The no action alternative was not considered responsive to the needs of the people.

Nonstructural alternatives such as flood insurance, improved flood warning systems and reliance on emergency protective measures, flood plain regulations and flood proofing techniques by themselves or in combination would partially reduce the present and potential flood problems of the watershed, but would not feasibly reduce potential damages to existing developments in the flood plain. Nevertheless, such measures are recognized as important supplements to the selected plan of development.

A permanent evacuation plan eliminating all damages is economically infeasible, especially in the lower watershed where the primary problem is the deteriorated condition of the existing conduit and the flooding that could result with its failure. In addition, evacuation is unacceptable to the people who would be directly affected.

Structural alternatives involving large-scale channel modifications and levees alone or in combination in the upper watershed would be economically infeasible or would be environmentally and socially undesirable.

An alternative involving repair of the existing conduit, another involving a new conduit in non-highway right-of-way, and others involving a new conduit along various other highway right-of-way alignments were investigated and found to be feasible but more costly than the selected conduit alignment.

An alternative involving an open channel with open space corridor in lieu of a new conduit is viewed by some local interests as a more

environmentally desirable plan since it would restore the creek to its natural state. The report recognizes this and identifies the open channel-open space alternative as the best plan from the standpoint of environmental quality (EQ). However, the report concludes that the open channel-open space alternative is unacceptable since the costs of development would far outweigh the benefits obtainable and to await the results of more detailed studies of the open channel-open space alternative would result in losing the opportunity to develop a cooperative conduit plan with the Minnesota Department of Highways. Development of the new conduit proposal would not preclude later development of the open channel-open space plan by local interests, although some of the flood control benefits of such a plan would no longer be attainable.

EVALUATION

Environmental Considerations - The selected plan was developed in response to concerns expressed by local interests who wished to preserve the aesthetic quality of Bassett Creek. Accordingly, such environmentally degrading features as channel modification and snagging and clearing were eliminated in the more environmentally sensitive areas of the creek in favor of temporary flood water storage which, because of short duration, would not cause a significant impact on the environment.

Coordination with the U.S. Fish and Wildlife Service and the Minnesota Department of Natural Resources resulted in development of a plan that would minimize adverse impacts on northern pike spawning habitat and yet adequately reduce flood damages to residences on Medicine Lake.

The selected plan includes excavation of three of the temporary flood water storage areas. Adverse environmental impacts could be expected during construction of these and other features of the selected plan. Adverse impacts on water quality and aquatic organisms would be temporary. Some long-term adverse effects would occur from embankment construction due to the removal of vegetation and the associated effects

on aesthetic qualities and wildlife habitat. The new outlet structure at Medicine Lake would be constructed in a wetland about 500 feet downstream of the lake.

Some long-term beneficial environmental impacts would result with implementation of the selected plan. The new conduit can be constructed with a barrier or placed at a steep enough slope to prevent the migration of rough fish from the Mississippi River into Bassett Creek. In the upper watershed the storage impoundments would retard high velocity flood flows thereby possibly reducing downstream degradation and aggradation problems.

Social Considerations - The selected plan would provide the flood protection considered necessary for Minneapolis and the other suburban communities in the Bassett Creek watershed. Direct benefits would accrue from the protection of some 222 residences and 18 industries located in the flood plain and an indeterminable amount of commercial and industrial development in Minneapolis that could be severely damaged if the existing conduit failed or became blocked during a flood. The selected plan would reduce the threat to life and the anxieties commonly associated with flooding.

The selected plan would place a social burden upon two families who would be evacuated from the flood plain and possibly upon those property owners whose residences would be raised or flood proofed. However, evacuation and flood proofing measures are considered optional. The property owner could opt for flood insurance or do nothing about his flood problems.

A preliminary cultural resources study by the St. Paul District, Corps of Engineers failed to identify any archeological or historical features of value in the project area. However, a potential for culturally valuable sites is felt to exist and more detailed studies would be made during the advanced planning phases.

Economic Considerations - Annual benefits and costs are \$949,000 and \$633,000, respectively for the project. The benefit-cost ratio is 1.5. In addition to an estimate for the prevention of present and future flood damages, the benefit estimate includes an estimate for early replacement of existing facilities and an estimate of the economic gains resulting from increased recreation opportunities and employment.

The opportunity to develop the plan cooperatively with the Minnesota Department of Highways also results in a significant economic gain. Without this opportunity the plan would still be economically feasible, but only marginally and the costs of the plan would be about \$5.5 million greater.

The selected plan would cause no significant adverse impact on the existing tax base of school districts. On the contrary, property values and hence the tax base could increase with implementation of the plan.

CONCLUSION

I find that the action proposed herein is based on a thorough analysis and evaluation of all reasonable alternative means for achieving the stated objectives; that wherever unavoidable adverse effects are found to be involved, they cannot be avoided by reasonable alternative courses of action which would achieve the congressionally specified project purpose; that the recommended action is consonant with national policy, statutes, and administrative directives; that where the proposed action results in an adverse effect, this effect is either mitigated or outweighed by other considerations. In addition, the Minnesota Department of Highways and the Bassett Creek Flood Control Commission and the communities it represents find the plan acceptable in concept. Accordingly, it is my decision that the public interest would best be served by implementation of the plan.

RECOMMENDATIONS

I recommend that the United States construct the flood storage and conveyance facilities, flood proofing modifications and related features in the Bassett Creek watershed at Hennepin County, Minnesota, for flood control, in general accordance with the plan selected herein, with such modifications thereof as in the discretion of the Chief of Engineers may be advisable at an estimated Federal first cost of \$7,231,000, non-Federal first cost of \$2,909,000 and non-Federal annual operation, maintenance, and replacement costs of \$10,000 provided that prior to construction, and in accordance with Section 221 of the Flood Control Act of 1970, local interests furnish assurances satisfactory to the Secretary of the Army that they will:

- Provide, without cost to the United States, all lands, easements, and rights-of-way including suitable areas for borrow and disposal of excavated material, as determined to be necessary by the Chief of Engineers for construction, operation, and maintenance of the project; such costs currently estimated at \$1,619,000.
- Hold and save the United States free from damages that may result from construction and maintenance of the project, not including damages during construction, operation and maintenance which are due to the fault or negligence of the United States or its contractors.
- Maintain and operate the project after completion in accordance with regulations prescribed by the Chief of Engineers.
- Share in the cost of the non-structural portion of the project in accordance with cost sharing provisions being developed under Section 80 of Public Law 93-251.
- Accomplish without cost to the United States all relocations and alterations of buildings (except non-structural measures), transportation facilities, storm and sanitary sewer systems, public and private utilities, local betterments, drainage facilities and

other structures and improvements made necessary by construction of the recommended plan, as determined by the Chief of Engineers, excluding facilities necessary for the normal interception and disposal of local interior drainage at the line of protection, such costs currently estimated at \$1,240,000.

- In acquiring lands, easements and rights-of-way for construction of the project, the local sponsor will comply with the applicable provisions of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970", Public Law 91-646, approved 2 January 1971.
- Prescribe and enforce regulations to prevent obstruction or encroachment on channels and ponding areas which would reduce their flood-carrying capacity or hinder maintenance and operation.
- Provide a cash contribution for recreation equal to 50 percent of the final separable cost allocated to this function less a credit for the value of lands, easements, rights-of-way, alterations, and relocations allocated therefore.
- Publicize flood plain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project.
- At least annually inform affected interests regarding the limitations of the protection afforded by the project.

Further, I recommend that non-Federal interests (the Minnesota Department of Highways or the local sponsor) be reimbursed for the full amount of any costs they might incur toward payment of the allocated Federal share of the cooperative drainage facilities currently estimated at \$1,951,000 and that such reimbursement apply retroactively to the period

preceding project authorization, if necessary, as well as to the period following project authorization provided that the design of the drainage facilities is accomplished in accordance with the criteria of the Corps of Engineers for flood control works as specified by agreement.

FORREST T. GAY, III
Colonel, Corps of Engineers
District Engineer

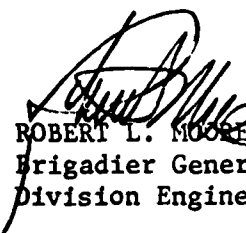
NCDPD-PF (Mar 76) 1st Ind

SUBJECT: Feasibility Report for Flood Control, Bassett Creek Watershed,
Hennepin County, Minnesota

DA, North Central Div., Corps of Engineers, 536 S. Clark St., Chicago,
Illinois 60605 10 May 1976

TO: HQDA (DAEN-CWP-C) WASH DC 20314

I concur in the conclusion and recommendations of the District Engineer.



ROBERT L. MOORE
Brigadier General, USA
Division Engineer

END

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